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NOTES ON THE SURFACE GEOLOGY OF EASTERN MASSACHUSETTS.

BY W. O. CROSBY.

THE prevalent line of strike in Massachusetts, as is well known, is north and south, and in the western half of the State there are no exceptions of importance to be noted. East of the Nashua Valley, however, a northeast and southwest strike prevails, especially in Essex and Middlesex counties; a comparatively limited area in the southeastern part of Worcester County exhibits a strike at right angles to this, or northwest and southeast; while among the Primordial and Carboniferous strata, a nearly east and west strike is most common.

"Geology is revealed in topography," and these fundamental structure lines find distinct expression in the leading topographic features of the State. In the Connecticut Valley and Berkshire County, where the geologic structure is simplest, this correspondence between geology and geography is most marked, and is observable not only in the grander features, — such as the Taconic and Hoosac ranges of mountains, and the Housatonic and Connecticut rivers, — but may also be readily traced in the courses of most of the minor streams and subordinate surface reliefs. East of the Wachusett range of highlands, we find, with greater complexity of geologic structure, two general topographic trends. The more prominent of these shows a close conformity with the prevalent strike, — northeast and southwest, varying toward east and west; while the other coincides with the transverse strike and the known direction of glacial movement.

Water and ice are the principal agents by which the topography of this region has been fashioned. Now there is little room to doubt that the sculpturing done by water exhibits, on

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the whole, a closer correspondence with geology than the reliefs shaped by the action of ice. This results from the essential unlikeness in modes of action of the agents in question. The topographic work done by rivers is effected mainly through degradation.

> "Time but the impression deeper makes,
> As streams their channels deeper wear."

The rivers of this section seldom deposit much material along their courses, and the detritus delivered at their mouths is usually transported to a greater or less distance, and finally laid down by the sea; so that this process, although the opposite of degrading, is more marine than fluvial. The action of the sea in modifying the contour of the land, on the contrary, is, generally speaking, twofold: degradation, which, when the waves work upon rocky shores, is determined more or less in direction and amount by the geologic structure of the degraded land; and building up, which operates by the transportation of loose materials and their accumulation at particular points, and depends mainly upon the direction and force of ocean currents, tidal waves, and prevailing winds, and upon the general shape of the land and ocean bed, though quite independent of their geological constitution, except mediately in so far as this has determined their form. In this region, such features as the outer end of Cape Cod, portions of Nantucket, the southeastern part of Martha's Vineyard, part of the coast of Essex County north of Cape Ann, and Lynn, Nantasket, and Duxbury beaches appear to be due to the constructive action of the sea; and of course they can be expected to conform in trend only imperfectly, if at all, with the features produced by degradation. The close correspondence between their forms and structure usually observable in those topographic details fashioned by the degrading action of the sea or rivers is, no doubt, largely due to the mobility of the water. It is by virtue of this wonderful property that the ocean possesses a power of discrimination, — a sort of tactual sense, as it were, — which enables it to act differently upon rocks having unlike constitutions, and thus, in effect, to dissect a rocky coast in a manner analogous to the unlocking of the molecular structure of a mass of ice by a transmitted beam of light. In striking contrast with this is the action of a large land glacier, such as exists at present in Greenland and Antarctic Land, and probably spread over New England at the time when the phenomena — drift and striated

and polished rock surfaces — commonly ascribed to glaciation were produced. The comparative immobility of a large glacier causes it to move almost as a unit, and, "strong in solid singleness," it can be swerved by none but the largest reliefs, especially in a region of gentle slopes and low altitudes like Southeastern New England. So that generally, only in so far as the fashioning of these reliefs has been determined by their structure can the progress of the ice-cap be regarded as influenced by the geological constitution of the land over which it moves. Hence we are led to conclude that surface lineaments resulting from a wide-spread glaciation will exhibit great uniformity of trend over wide regions, and a general independence of the structure of the subjacent rocks; and such is conspicuously the fact in Eastern Massachusetts.

There are perhaps no surface features which are more clearly the product of glaciation than the lakes and ponds found, and as a rule found only, in glaciated regions, and which abound in New England. The great extent to which regions which have been subjected to the action of an ice-sheet are distinguished by the presence of lake basins becomes more apparent when we reflect that, as has been pointed out by Professor N. S. Shaler, these basins are probably much fewer and smaller now than when first formed at the close of the glacial epoch; for "there are in operation in the regions characterized by glacial lakes no forces capable of producing such depressions; on the contrary, all the forces at present in action tend to obliterate the existing basins." Professor Shaler has called attention also to the facts that these lake basins seldom, "except the smallest, present any approximation to a circular figure;" and that "the major axis has usually a north and south trend." The following data (derived from approximate measurements, made on good maps, of the ponds and lakes of Eastern Massachusetts) show, among other things, how general is this elongation in a north and south direction. Two hundred and ten basins were measured, including all but the very smallest, in that portion of the State east of Worcester. The mean direction of all the major axes is about N. 5° W. The mean ratios of the major axes to the minor axes is 2.5; that is, the ponds are, on an average, two and one half times as long as broad. The average trend of the longer diameters, it will be observed, coincides very closely with the mean direction of the glacial striæ of this region, and the courses traversed by erratics. In only thirty of the two hundred

and ten basins measured does the direction of the major diameter vary more than forty-five degrees from the general average, N. 5° W.; while ninety, or nearly one half the whole, deviate less than ten degrees from it, and only thirteen are found falling within ten degrees of a direction at right angles to the mean, or N. 85° E. The mean ratio of the major to the minor diameters for these ninety ponds is 2.4; but for the thirteen it is only 2. The extreme range of the glacial striæ of Eastern Massachusetts, according to Professor Edward Hitchcock, is from N. 5° E. to N. 55° W., — sixty degrees; and it is found, on examination, that the courses of fully two thirds of the ponds lie within these limits.

Terminal moraines appear to have been formed at very infrequent intervals in this region; the Elizabeth Islands, however, constitute a fine example of such a moraine, rendered conspicuous by its isolation; and others are known to exist inland. Wherever occurring, they must, of necessity, have approximately east and west trends, and bodies of water bordered by them will share the same course. In this way I conceive we may account for some of the extreme deviations from the mean trend observed among the lake basins. This explanation fails in many cases and yet these offer no special difficulty, for a more detailed consideration of our data shows a slight dependence of the phenomena in question on the general plan of the geologic structure of the region. Thus, in Essex, Middlesex, Norfolk, and Bristol counties, and all but the southeastern part of Plymouth County, where the predominant strikes among the rocks are east and west and northeast and southwest, we find the average relative dimensions of the ponds expressed by the number 2.3: while in the eastern half of Worcester County, where the prevailing strikes range from north and south to northwest and southeast, that is, are generally parallel with the line of march of the ice-sheet, the ratio of the average length to the average breadth has the comparatively high value of 3.15. Hence, we see that, while the lacustrine depressions are, as a nearly universal rule, elongated in the direction of glacial movement, the amount of this elongation is sensibly less where the progress of the ice-cap was transverse to the general strike of the underlying rocks than where it coincided with the strike. Another fact brought out by a comparison of these data has the same significance, namely: the deviations from the mean trend of the basins are fewer and smaller where the direction of the glacial motion

coincides with the strike of the rocks than where it is transverse to the strike. Thus, in Essex and Middlesex counties the trends of one half the ponds deviate more than twenty degrees from the mean, while in Worcester County the proportion is only one fourth.

One of the most remarkable facts in the distribution of glacial detritus, or drift, in Massachusetts, is the comparatively great depth to which it has been accumulated over the southeastern portion of the State. There is a marked paucity of rock outcrops in the southern half of Plymouth County; south of Plymouth and east of Middleborough they are rarely met with; and Barnstable County is absolutely destitute of them. It is not improbable that the solid rocks in this region are so deeply buried by the unconsolidated superficial deposits that if the latter were removed, the whole of Barnstable County and a considerable part of Plymouth County would be invaded and covered by the sea. Professor Edward Hitchcock, in discussing this subject, estimated the maximum depth of the drift in this region at not less than three hundred feet; and he evidently believed it to exceed this. Certainly here, if anywhere, we may expect lake basins and river valleys to exhibit in their forms and trends a complete independence of the underlying rocks. This expectation is justified by the facts. There is not in the region under consideration a stream of any considerable size that has not a north and south course, although the strike of the underlying rocks undoubtedly approximates east and west. As a result of this parallelism of the water-courses, we find no streams of any importance cutting the north and south coast-lines; the western shore of Cape Cod Bay between Elisha's Point and Scusset Harbor is almost unbroken by debouching streams, and Buzzards Bay receives not a single tributary from its eastern shore. Coast-lines transverse to the direction of glacial action, on the contrary, are fretted with river mouths and long, fiord-like bays and inlets, as the northern shore of Buzzards Bay and the southern coast of Falmouth. The evidence from the lake basins is almost as unequivocal as that from the rivers. Measurements of all but the smallest basins between Orleans and a curved line extending from Kingston southerly to the mouth of Wareham River, convex to the west and including Simpson's Pond, give north and south as the average trend or direction of the major diameters, and 2.7 as the ratio of the length to the breadth, or the mean elongation.

A comparison of the lacustrine depressions of this region of excessive drift with those of Worcester County, on the one hand, and of Essex, Middlesex, Norfolk, Bristol, and Northern Plymouth counties, on the other, shows that the value of the mean elongation in the former district, 2.7, is intermediate between the values of the same property in the two latter, 3.15 and 2.3, respectively. And thus we are brought to the following general conclusion: where the drift is so deep that the forms of the lake basins have no necessary relation with the subjacent rocks the mean elongation of the depressions is greater than in districts where, the detrital sheet being thinner and less universal, the basins are partially rock-bordered, — when the progress of the ice-cap was transverse to the general strike or structure lines of the rocks, — and less when this movement coincided with the strike.

The reliefs of this region are, for the most part, of very moderate altitude; and, in consequence of the sharper contrast between land and water than between hill and valley, they are seldom represented on maps with even an approximation to the accuracy characterizing the delineation of water-bordered contours. Hence it were futile to attempt to discuss our hills and ridges in the same manner as the lake basins and river valleys. Fortunately, however, the general facts are so plain that they do not require this for their elucidation. It is in the experience of most observers in this region, that the drift hills have usually a lenticular outline, are more or less ridge-like, and that both hills and ridges coincide in trend with the direction of glacial movement. Those remarkable drift ridges in Essex County, described by Mr. G. F. Wright, and extending with a nearly rectilinear course from beyond the New Hampshire boundary to Massachusetts Bay, exemplify in a striking manner the form, trend, and general independence of geology characterizing our drift topography. Elevations composed mainly of rock *in situ*, on the contrary, express in their forms and trends the leading geologic structure lines of the region, but do not admit of correlation with the course of glacial action. The Wachusett range of highlands, the parallel range forming the eastern rim of the Nashua valley, the somewhat irregular belt of hills extending from Cape Ann to Beverly, the well-known range sweeping with a bold front from Swampscott to Waltham, and the Blue Hill range in Milton and Quincy are good examples of the more prominent and general of our rock reliefs. The first

two are fashioned from stratified rocks, and are more regular and distinct than the others, which are for the most part composed of unstratified rocks. Yet the latter, no less than the former, reveal the structure of the rocks composing them; for exotic rocks, being, in a certain sense, structureless, only conform with the general law in giving rise to a systemless topography.

The notion appears to be gaining ground among geologists that the power of a continental glacier to degrade the surfaces over which it moves, or, at least, to alter the forms of those surfaces, has been greatly over-estimated. It has become unnecessary, in the light of recent investigations, to ascribe to the active agent of the drift epoch, whether land-ice or icebergs, great abrading power in order to account for the formation of the truly immense and generally chaotic mass of superficial detritus constituting the drift; for in the subaerial decomposition of rocks, especially crystallines, *in situ*, during immense periods of time, we have a process fully competent for the production, both in quantity and quality, of the detrital materials, including bowlders, found in glaciated regions. The real degradation, the formation of the detritus, is mainly the work of chemical and not of mechanical forces. The sheet, usually thirty to forty, sometimes fifty, and even one hundred feet in thickness, of thoroughly decomposed materials passing insensibly into solid rock below, found over a large portion of the Southern States, and occurring generally wherever there are crystalline rocks in low latitudes, is a substantial monument to the degrading power of these silent agents, which are doubtless still in operation. As a nearly universal rule, we find the drift in New England reposing upon smooth and polished surfaces of undecomposed rocks, which evinces that the glaciating agent had sufficient erosive power to sweep away all traces of the zone of partially decomposed, semi-rock-like material that in the South intervenes between the firm rocks below and their decomposed skeleton above, and which probably existed over glacial latitudes in preglacial times. The theory of subaerial decomposition so far diminishes the erosive power required, by previous hypotheses, in the agent of glaciation as to render possible a reconciliation of the existence of an ice-cap in quite recent geologic time with the well-known fact that many reliefs of comparatively small magnitude have trends and contours wholly at variance with the courses of glacial movement, and incompatible with the supposition that the ice-sheet moved as a rigid, unyielding rasp, removing hundreds of feet of solid rock from the surface of the country.

It appears probable that but few of those surface unevenesses which are impressed upon the rocks have had a glacial origin. At any rate, a large number, including all the more important, of these rock-impressed inequalities of the surface in this region are doubtless much older than the glacial epoch which has but recently passed away, and, if due to glaciation at all, were sculptured during some earlier reign of ice. Such large rivers as the Merrimac, Nashua, and Blackstone are unquestionably of preglacial origin. Their courses are parallel with the strikes of the rocks over which they flow; and the first two, at least, occupy well-marked geological valleys. Furthermore, it is hardly conceivable that glaciation can have been the cause of rock-bordered valleys transverse to its line of action, as is the Merrimac in Massachusetts; and the valley of this stream, so far from being the product of glaciation, probably exists in spite of the tendency of the ice-cap to obliterate it.

The question, also, as to what extent the so-called fiords of this region are due to the excavatory power of ice during the last glacial period can hardly be regarded as settled. Reference is made, of course, only to fiords carved from the solid rock, which is not the case with those in Barnstable County. The fact that these inlets are chiefly found on coasts transverse to the direction of glacial movement becomes, I think, less an obstacle to the denial of their glacial origin, when we reflect that the tendency of an ice-cap would be to fill up and obliterate such coastal inequalities as were transverse to its line of progress, and at the same time to clean out such as coincided with its march. If the superficial deposits were removed from the New Hampshire coast, the northeastern part of Essex County, and Eastern Plymouth County, it is not improbable that these north and south shores would present irregularities nearly as marked as those that indent our southern coast.

It is a significant fact that the northern shore of Massachusetts Bay, though parallel with the northern shore of Buzzard's Bay, and hence similarly related to the course of glacial action, is destitute of conspicuous indentations that can be regarded as the work of the ice-sheet; for all the important rock-bordered deflections of this coast-line have their major axes transverse to the line of march of the glacier. Marblehead harbor is one of these northeast and southwest troughs; and here we have evidence of a unique and conclusive character, proving beyond question its preglacial origin. This strait — for such it would be

but for the bar across its southwestern end — is a well-marked depression, and has clearly been formed by the erosion of the ancient Huronian granite, petrosilex, and diorite, by which it is bordered. Near the middle of the southwest side of the harbor, visible only at low tide, is a hard, whitish, fine-grained sandstone or arenaceous slate. It overlies unconformably the banded petrosilex found on this shore: the petrosilex dips steeply to the southeast, while the sandstone has apparently, a gentle dip in the opposite direction. Interposed between the petrosilex and sandstone is a thin stratum of conglomerate, composed of pebbles of the former. Obviously, Marblehead harbor was excavated before the deposition of this sandstone, which can hardly be newer than the Carboniferous period, and is probably coeval with the Primordial rocks in the vicinity of Boston. Other remnants of the sandstone are scattered over Marblehead neck, in such positions as to indicate that the granite and petrosilex of which the neck is mainly composed have suffered but little erosion since the formation of the sandstone. The removal of the sand-rock from the harbor, which it doubtless once filled, may have been the work of ice in recent geologic times; but the harbor itself must have had substantially its present form before the close of the Palæozoic era. Salem, Beverly, Manchester, and Gloucester harbors have also been cut out of Huronian or still older rocks; and, when we consider their striking resemblance in form and trend to Marblehead harbor, it is difficult to avoid the conclusion that they have an antiquity equally great.

The limitation of fiords to high latitudes and to coasts favored with an abundant precipitation of moisture (usually western coasts), that is, to coasts most favorable for the formation and development of glaciers, certainly appears a sufficient warrant for the commonly accepted opinion that these deep, narrow, and ofttimes tortuous channels are the product of glacial erosion, the more especially since fiord valleys usually exhibit, in the form of moraines and striated and polished rock surfaces, unmistakable traces of the former presence of glaciers, and in some regions are occupied by existing ice streams. Yet this theory fails most signally to adapt itself to some phenomena of an important and general nature. Mr. James Geike, in The Great Ice Age, says that some of the fiords of Great Britain are known to date back to the Devonian age, and that, though many may have been deepened by ice action during the last and earlier glacial epochs, they were *all originated by streams and rivers in*

ages long anterior to the Post-Tertiary ice time. Valleys must precede valley-eroding glaciers.

From our remote northwestern coast we have yet more conclusive testimony to the preglacial origin of the phenomena in question. In no region, save perhaps the western coast of Norway, is there a grander development of fiords than on the Pacific coast of North America, from the labyrinth of Vancouver Island northward. These fiords are cut in the seaward slope of a bold mountain range, bearing the lofty peaks of Fairweather and St. Elias. According to Mr. W. H. Dall, almost every fiord of considerable size on this coast, especially toward the north, "has at its head a glacier, or the remains of one. Some of these glaciers are of extraordinary size and grandeur." The same authority states that evidence is wholly wanting that these glaciers ever much exceeded their present limits. The walls of the fiords, short distances below the present terminations of the glaciers, are not smoothed or striated; and no terminal moraines stretch across the fiords, or form shoals at their mouths. These are typical fiords, and yet the evidence that they are not due to the action of ice in any recent geologic time is rendered conclusive by the occurrence in some of the fiords having glaciers at their sources, according to Mr. Dall, of islands composed of soft and yielding Tertiary strata, which must have been completely swept away had the ice streams ever filled the gorge. The existence of these Tertiary beds is a certain indication that the fiords antedate that period, and hence they are, in a certain sense, the cause rather than the consequence of the present ice streams.

The tendency of the considerations here presented is evidently toward the view that, comparatively speaking, the ice-cap rested lightly upon the land, and that the topographic features having a skeleton or frame-work of rock are, as a rule, of preglacial origin. In other words, it appears probable that if the present mantle of drift were entirely removed from the face of the country, leaving a surface of naked rock, we should have in all important respects a restoration of the anteglacial contours. And this ancient topography having been, as I conceive, fashioned mainly by agents more subtle than an ice-cap, and hence taking a deeper hold on geologic structure, would if thus undisguised reveal a closer correspondence with the structure lines of the subjacent rocks than we are able to detect in the existing hills and valleys considered as a whole.

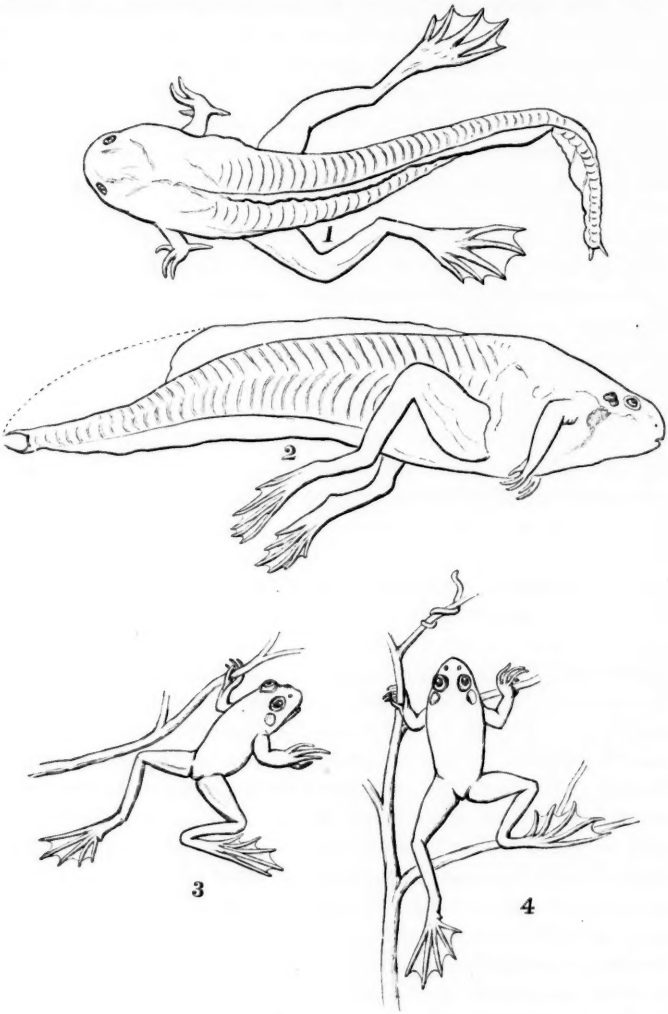
The uniformity of trend in glacial striæ and drift transportation observable over wide regions appears inconsistent, at first view, with the supposition that the ice-cap had but little erosive power: a contradiction seems implied in the possession by a glacier of a magnitude and rigidity which enabled it to move without deviation over prominent reliefs, and a general inability to erode those reliefs. How can we harmonize the lightness of its tread with its rectilinear march over uneven surfaces? That ice in glacier masses behaves essentially as a very viscous liquid is well known; and a solution of the problem is found in a peculiar condition, pointed out by many writers, and necessarily existing in a continental glacier, which limits the freedom of motion among themselves, possessed by the different portions of the ice-sheet, to a vertical direction. Lateral deviation is rendered impossible by the inferior plasticity of the ice; and hence, when any portion of the ice-sheet encounters an obstacle, around which it would flow if sufficiently fluent, it is found easier to overcome the gravity of a small mass of ice than the cohesion of a relatively large mass, and the ice, moving in the direction of least resistance, passes in a vertical plane over the obstruction.

PSEUDIS, "THE PARADOXICAL FROG."

BY S. W. GARMAN.

PSEUDIS is a peculiar South American frog, peculiar in the fact that it grows smaller as it becomes adult, and in possessing a nearer approach to a thumb than any of its relatives. It is much to be doubted whether there is anything in the actual history of an individual belonging to this genus that calls for an amount of notoriety to which the most common toad or frog may not aspire. To be sure, the tail is kept long after all the legs appear; the tadpole is larger than the adult, and the creature has a hand in which the thumb is opposed to the three fingers, yet all these are hardly enough to demand the amount of attention of a certain kind which the genus has received. In fact, as often happens in the case of men, Pseudis owes much of his reputation to a mistaken estimate. If we might trace him from as early a period as men have seen until well advanced in life, we should probably see nothing more than takes place in the history of all batrachians. We might meet the egg first coming within the limits of our vision as a round, granule-like body be-

tween the cells of the corpus graffianum in the ovary. It would gradually acquire a membranous covering and a germinal vesicle



(Fig. 97.) PSEUDIS.

1, 2, Batrachichthys, from Ann. Mus. Nac. Rio de Janeiro, Vol. I., Pl. VI.
3, 4, Pseudis minuta, from Nature.

with the inclosed germinal dot; or, better stated according to Agassiz's nomenclature, it would appear as an ectoblast contain-

ing a Purkinjean vesicle (mesoblast), within which rests a Wagnerian vesicle (entoblast). If we were to follow the egg closely through its different conditions we should see it dropping from the ovary at maturity, passing to the mouth of the oviduct, and through it thrown out into the waters at the same instant that it receives the life-imparting sperm from the male.

If Newport did not mistake, we might see the snake-like spermatozoön work its way through the envelopes to the surface, where, breaking into granules, its identity is lost in the substance of the yelk. Then we should notice the beginning of segmentation, its progress, and the successive changes of form in the embryo, until it tears the shell, and with great, wondering eyes stares out upon its watery world a tadpole. While a big-headed slender-tailed tadpole we should find much of interest in the *Jackie*, as called at home, but in the main the story might be told with approximate accuracy from one secured in the nearest pond. After leaving the shell his manner of life would resemble in most respects that of any other passing through the same stages. He might be seen at one time busily engaged grubbing along on the bottom for whatever eatable might come in his way (and he is not at all particular as to his food), or with many companions lying quietly at rest, starting every now and then like the Turk from his dream, rushing frantically to the surface for a mouthful of air, then tearing back as if his very life depended upon haste, placing himself on the mud as before, just as if nothing whatever had happened. At another time, with a whole group of his fellows, he would be seen to start upon an extended migration as though he had determined to leave the scenes of his youth forever behind him. Often he might be observed to gnaw for some moments at the sides of the leaves of the water-plants, all the while wagging his tail and appearing as jolly as if he had as much real enjoyment in eating as a pig or dog. Then again he would be seen to take a nap with his nose just against the surface of the water, and on being waked suddenly to bury himself deep in the ooze below.

But all the time he would have nothing in the world to do but eat and grow and keep out of the way of hungry enemies. He would eat to some purpose and grow to a size considerably greater than that of the adult. In the mean time the hind legs, with the broad-webbed feet appear, and the arms and hands with the peculiar thumbs. Here he rests for a time as if altogether uncertain whether further change is for the better. In fact, he

loses by the next change, for when it has passed he is smaller than when it began.

His first mention in literature takes him up at this period. Through some Dutch collectors in Surinam, Albert Seba secured specimens of the adult and of the large larvæ with and without limbs. Comparing the smaller with the larger he came to the conclusion that the development was retrograde: that the animal was first a frog, then acquired a tail, then lost its limbs, and finally — the remote resemblance between the coils of the intestine and the sucking disk of the gobies probably suggesting the idea — became a fish. His conclusions with sketches were communicated to Mlle. Marie Sybille de Merian, who published them in her work on the Insects of Surinam, citing Seba as the source. The latter published the same a few years later in his Thesaurus (volume i., plate 78, 1734), where he gives a series of figures illustrating the transformation of the frog into the fish. This version of the story was at first accepted by Linné (Mus. Ad. Fridr., 1754) and by Edwards (Phil. Trans., volume li.). In the tenth edition of the Systema Naturæ (1758–59) Linné corrects the matter, and the name *Rana piscis* of Merian gives way to *Rana paradoxa* Linné. From that time until within a year the "frog-fish" seems to have known his place. Wagler, in 1830, applied the name *Pseudis*, on account of the errors into which the early observers were led, and the genus then established under this title has been generally accepted by authors.

Last year a chapter was added to the history of the "paradoxical frog," which refers us back to the beginning. Page 31 of the *Archivos do Museu Nacional do Rio de Janeiro*, volume i., 1876, second and third trimesters, contains an article with this title: Nota descriptiva de um pequeno animal extremamente curioso e denominado Batrachchythis, by Dr. Pizarro. From the description and the figures on plate vi., it is not difficult to recognize our old friend the young Pseudis, of whose peculiarities the doctor does not seem to have been aware. There is little doubt that *Batrachichthys* — to whom the author calls the attention of Messrs. Darwin, Haeckel, and Martins — will ultimately go through his transformations, become a veritable Pseudis, and be degraded from his position as connecting link between fishes and batrachians. Should he go no further, as is barely possible, he would even then be only a link between the adult and the tadpole, and no more closely allied to the fishes than either. In this case, which is only a supposition, his standing

would be to the frogs just what that of the axolotl is to *Amblystoma*. What information the author has given us with the description and figures of the single specimen that has come to his notice will not allow the assumption that the representatives of the genus in Paraguay differ from those in Surinam in respect to the length of time passed in the larval stage. It is well known, however, that in other batrachia the metamorphosis can be hastened, or retarded, or prevented, as may be desired; that the time varies in different seasons and localities according as they may be favorable or otherwise; and that in species of a single genus, as *Rana*, the metamorphosis occupies weeks in some cases, years in others. Dr. Jeffries Wyman is said to have kept larvæ of the bull-frog seven years, more than twice the ordinary period of existence of the animal in the larval stage. More information concerning the species of Pseudis (*P. paradoxa*, *P. minuta*, and possibly a third for *Batrachichthys*) is desirable.

A little exercise of imagination enables one to see them grasping and swinging from the branches of the plants by means of the opposable thumb; whether this is its use is a question. One can imagine the tail and feet both required in the pursuit of rapidly moving prey or in escape from lively enemies, but it is only supposition.

However, we shall wait another chapter in the history before accepting *Batrachichthys* as one of the "missing links;" the reputation of Pseudis as a deceiver is too well established.

ON THE ANCIENT AND MODERN PUEBLO TRIBES OF THE PACIFIC SLOPE OF THE UNITED STATES.[1]

BY EDWIN A. BARBER.

IN the far Southwest, covering far the greater part of that section of the United States now known as Colorado, Utah, New Mexico, and Arizona, and stretching through the great valleys of the Rio San Juan and its tributaries, the Colorado and the upper portion of the Rio Grande del Norte, there exist the ruins of thousands of stone structures, built by a prehistoric race whose individuality has been lost in the obscurity of past ages. The great extent of territory which the remains cover, and their great number, would indicate a former population of at least half a million souls.

[1] Read before the American Association for the Advancement of Science, at Buffalo, 1876.

At the present day there are two tribes of semi-civilized Indians in New Mexico, known as the Pueblos and the Zuñis. These people live in permanent stone houses which resemble closely in architecture the deserted ruins to the north. In the northeastern part of Arizona, situated in longitude 110° to 111° west, and latitude 35° to 36° north, are the seven towns of the Moquis, a tribe closely allied to the Pueblos and Zuñis, and doubtless a branch of the same ancestral stock.

The object of this paper is to give some facts which will help to prove that the ancient people with whom originated the ruins of this section were the ancestors of the three house-building tribes just mentioned.

The question which first presents itself to our minds is, *Who were the architects of these ancient and extensive ruins?* In striving to solve this problem, let us in the first place glance at a few of the traditions of the barbarous tribes which occupy this portion of North America. Although traditions and legends are by no means data from which to draw conclusions, nevertheless they may be of interest in this connection, as showing the ideas which the present Indians of the West entertain in regard to these ancient ruins and their creators. Moreover, we can detect in many of these "imaginings" a remarkable similarity through different and widely separated tribes, which fact lends to them at least a semblance of probability.

The Moquis of Arizona profess to have among them an ancient tradition which runs in this wise: The entire country covered by ancient habitations was occupied long ago by a peaceful, agricultural, and pastoral race, from the time the earth was but a small island. Here they flourished and multiplied for many generations, tilling the soil and raising flocks and herds along the fertile river valleys. After a time another tribe, uncultivated and barbarous, came down from the north to visit them.[1] The people received them kindly and treated them in a hospitable manner, and their visits grew more frequent. Finally they became annoying and showed a warlike spirit. The owners of the land then fled to the cliffs, and subsisted as best they could, until the barbarians from the north came down with their families and settled permanently, driving their victims from the country. Then the persecuted people gathered together once more at the *Cristone* (a needle-shaped spire of rock on the San

[1] These latter were undoubtedly the ancestors of the Utes and other savage tribes which formerly occupied that section.

Juan River). Here they built houses in the caves and cliffs; erected fortresses, watch-towers, and store-houses; and dug reservoirs to supply themselves with water. After a prolonged battle their enemies were repulsed; but the conquerors retired to the deserts of Arizona and settled on the high bluffs of that region, where their posterity, the Moquis, live to this day.

Accounts of this people, orally transmitted from father to son, exist among the Ute Indians of Southern Colorado, to the same effect. They claim to be the descendants of the race which conquered the builders of these pueblos. They evidently believe that the architects were ancient Moquis, and if asked who originated these ruins will invariably answer, "Moquitch." I had some curiosity in regard to the opinions of the Ute Indians on this point, and availed myself of every opportunity to make inquiries. I asked one old warrior who built the houses around us, and his reply was, "Moquitch." Of another who sat watching us intently as we made some excavations, I inquired what people were buried here, to which he answered, as usual, "Moquitch." From several Indians of separate bands I received the same reply in regard to the pottery, arrow heads, etc., and I soon discovered that this was at least the prevalent belief throughout the whole tribe.

The Navajos are said to possess traditions of the same nature relative to the aboriginal people; but I was unable to gain any information from those we met in Arizona.

I am led to think from the many evidences which are presented to us that the original people retired from the north southward. This supposition agrees with the traditions of the natives and is supported by the general appearance of the remains. Those farthest north are in the greatest state of decay, while as we advance southward they are much better preserved. Through New Mexico and down into the southern part of Arizona the ruins of buildings and pottery possess a more recent appearance, and there can be no doubt that these (south of the Pueblos, Moquis, and Zuñis) are, to a certain extent, of *comparatively* late date, extending back, perhaps, only to about the first quarter of the sixteenth century, when the Spaniards marched across the country. Many of the ruins along the Gila and in the neighborhood of the Pueblo tribes of New Mexico are simply the remains of a century or two, although in *some* localities they are much older. There can be not the least doubt, however, that all north

of the Rio San Juan, and those to a certain distance south, are of exceedingly great antiquity.

On visiting the seven Moqui villages after passing through the ruins of Southern Utah and Northern Arizona, the archæologist is first impressed with the remarkable similarity which exists between the architecture, utensils, and implements of the ancient and modern peoples. The architecture of the Moquis, especially, resembles strongly that of the ancient Pueblos. The houses are very ancient, and were built certainly more than four centuries ago, as they were found by the Spaniards about the years 1539–1541, in the same condition, almost, as they are now. At that time they had been occupied for years, and north of them the same buildings which are now crumbling in ruins were deserted. The Moqui towns were known to the discoverers as the "Province of Tusayan." The houses are made of stone, after the manner of the ruins, the walls being massive and squarely built. The stones are laid in adobe mortar without lime, and the walls are plastered externally and internally with mud, which has given some explorers the erroneous idea that they are adobe structures. Space will not permit me to enter into a description of the architecture and an exhaustive comparison of the methods of building of the two different periods of time. The general form of the Moqui houses is identical with that of the ancients, and the materials used are the same in both cases. Both were generally approached by ladders, and the more recent Moqui buildings were built on high mesas, just as the older structures were usually set in the cliffs and caves, for protection from enemies.

In general form and appearance the earthenware of the two ages corresponds. The process of manufacture was the same in both, and the resulting utensils vary but slightly in any respect. To be sure the modern ware is inferior in quality to the ancient, and lacks that finished glazing which characterizes the latter. The same geometrical designs are common to both, and are painted in colors, usually black, red, yellow, or white. Among the ruins the fragmentary pottery is very abundant, being scattered over hundreds of miles of country. For each ancient form of vessel a corresponding one may be found in the modern Moqui ware. It may be argued by some that the Moquis did not inherit the art from the ancients, but simply imitated in shape and finish the numerous specimens which still remain of the old Pueblos. This, however, seems not at all probable, for the Moquis seldom leave their own towns, and few, if any of them, have ever visited those ruins which abound in this ware, along the San Juan River.

The art is an ancient one and has undoubtedly been handed down from generation to generation, with few modifications or alterations, and no improvements. It would be a very singular circumstance if this particular tribe should pattern after an earlier race (having no connection with it), while the other tribes of this section, as the Utes, Navajos, Apaches, etc., though living to a great extent *in* the very ruins themselves, and still practicing the art of molding clay, do not imitate the ancient pottery, but possess their own peculiar methods.

The most common stone implement to be found among the *débris* of the ruins is the corn-grinder or rubbing-stone, which in form is long and flat, made of sandstone, basalt, or coarse-grained *pudding-stone*, and measuring some ten or twelve inches in length, four in width, and an inch or so in thickness at the centre. These grinders have been rubbed down by use, flat on one side and sloping on the other from the centre to the edges, giving each stone a three-sided appearance. There is another form of this tool which is usually made of the coarser-grained materials, being oblong, probably four to six inches in length, four in width, one to two in thickness, and flat on both sides. Several of these we found in a state of completeness, while of the former we found but one perfect specimen. Accompanying such objects in many of the ruins were large, square, flat stones, a foot or fifteen feet square and a few inches deep, which had been hollowed out by long rubbing on the upper surface. These were the millstones or *metates*, on which the corn was ground with the aid of the rubbing-stone. Through Southern Utah and in Arizona we found several perfect millstones and scores of fragments, which we were unable to transport on account of their great weight.

The same implements are found in use at present among the Moquis. In every house there is a series of three or four of these mills with their grinding-stones. From the presence of these among both the ancients and moderns, their modes of labor, at least, are shown to have been similar.

Great stone mortars and pestles occur among the ruins, and on the tops of the Moqui dwellings they are still numerous, though for the most part are now not used. In the centre of the open court of Tegua there is a pile of large stones, among which is a huge stone hammer or maul made of hard sandstone, measuring about a foot in length and weighing at least twenty-five pounds. This resembles closely some which were discovered among the

San Juan ruins, several of which weighed twenty pounds each. Comparatively few of the old stone implements still remain in the Moqui tribe, having been replaced by iron tools. Those which yet exist are not in use, but are kept as relics of a past age. Many of the inhabitants can recollect when metal was first introduced among them, although it had been employed among the nomadic tribes of that district for centuries.

The rock inscriptions, which are everywhere visible in the vicinity of ancient mural remains, are also found on the cliffs and walls of the plateaus on which the seven Moqui pueblos are built. These latter are very old, and the present people know nothing of them except that they were engraved there by their forefathers very many years ago. Frequently the same designs and figures are observable which adorn the rocks in the desert country to the north.

From the above brief comparisons of the productions of these modern and ancient peoples, it becomes very evident that they possessed the same customs, habits, and to a great extent modes of labor. Further than this, they were both architectural and agricultural peoples, and both paid homage to the sun, or at least looked for a Messiah daily to come to them from the east. Many of the ancient houses (as those in the cañon of the Mancos) faced toward that direction, and here the inhabitants might continually watch the eastern heavens; the Moquis still mount the roofs of their houses and wait expectant while the sun rises each day to view.

The modes of burial are also the same as formerly, except that cremation is not practiced now by the peaceful tribes as it was during times of war, centuries ago. We find no *large* mounds for the purpose of sepulture among the ruins of this section or through the Moqui burial grounds, yet the graves in both cases are marked by upright stones set on edge in the soil, and much pottery is strewn over the surface.

After briefly reviewing these facts, we arrive at the following conclusions: In the first place we know that an ancient race, agricultural, semi-civilized, and well advanced in the industrial arts, peopled this portion of the West. From the traces of once cultivated fields, now overgrown frequently by the *Helianthus*, through the river valleys, and the impressions and even the presence of corn-cobs in the mortar, and of burnt corn-cobs in burial urns, we arrive at the conclusion that the people were agricultural. That they were well along in the arts may be seen in the

proficiency to which they attained in the manufacture of pottery, the shaping of instruments and utensils, and the building of stone houses.

The original people inhabited a great extent of territory, covering many thousands of square miles, and must, at one time, have been a powerful race.

The ruins bear on their faces the impress of great antiquity, how old none can tell. Yet they were built long before those pueblos in Arizona and New Mexico, which are occupied by the present industrial tribes, and which were standing as they now are at least three and a half centuries ago, when the Spanish expeditions visited them. That the same people who built the ruins erected these more recent habitations there can be no doubt. This can be satisfactorily proved by a comparison of the architecture, implements, hieroglyphics, and other productions of labor, besides the characteristics of the people, their habits, manners, customs, religious ceremonials, etc., and we must therefore admit that they extend back, at the very lowest calculation, four hundred years, and in all probability much farther.

The modern Moquis of Arizona and their allies, the Pueblos and Zuñis of New Mexico, who dwell in towns situated to the east and southeast of the villages of the former, undoubtedly possess a common ancestry, as inferred from their similar habits and the glimpses we obtain of their ancient history. It is believed, if it be not an established fact, that those ancient ruins which are so common in New Mexico originated among the prehistoric Zuñis and Pueblos, just as those same remains which are found in Colorado, Utah, and Arizona are supposed to have been built by the ancestors of the Moquis. Therefore it may reasonably be *inferred*, at least, that the three tribes originally descended from the same ancestral stock. It consequently matters little what we call the ancients, whether Moquis, Zuñis, or Pueblos, although for convenience and on account of their architectural peculiarities, we may term them the *ancient Pueblos*, or town builders.

All through the great extent of country, once inhabited by this people, we find stone implements of every degree of proficiency of manufacture, from the rude pebble which has been picked up from the river-bank and used as a hammer to the carefully fashioned and smoothly polished Neolithic tools which are examples of a highly perfected art. But the improvement ceases here. No vestiges of bronze or iron have yet been found.

In many of the remaining walls of the ancient buildings, the

stones have been trimmed symmetrically into cubical and rectangular blocks; but it can be clearly seen upon careful examination that the work was *not* accomplished through the agency of metallic tools. In several instances where the crude cedar framework of the apertures was still preserved, or where the wooden beams projected between the stories, we noticed that the ends had been cut or hacked with blunt stone axes. Everything in the architecture of the buildings, indeed, indicated the employment of dull implements except in the masonic labor, where simply the hands of the workmen performed all the requirements of such work.

Among the pottery we found many handles of utensils which had almost invariably been hollowed out to give them as little weight as possible; and this was done, not by the use of iron or copper wires, but by means of straws and slender sticks, which left in the wet, plastic clay their perfect impressions. These were used, doubtless, for the purpose of strengthening the handles while in a plastic state.

The people were driven from the land by another powerful race, as is evident from the many indications which exist on every hand. The great numbers of arrowheads and warlike weapons in the vicinity of all of the larger structures, the quantities of shattered pottery, which in some measure resulted from the attacks of enemies, the appearance of the houses among the almost inaccessible cliffs, and the evident desire of their builders to conceal them from view by such artifices as imitating in them the texture and color of the surrounding rocks, — all these facts point to one conclusion: that the people were forced to migrate southwards by an irresistible enemy.

To *some* extent, however, extreme drought may have been instrumental in this depopulation, for there are thousands of indications that the country was at one time well watered both by running streams and springs, and by artificial *acequias*. The entire country must have undergone since its occupation a great physical change, in being transformed from a fertile, well-watered tract into a dreary, barren waste, and this alteration may have commenced toward the latter part of the existence of the ancient empire. Some time must have been required to effect this change, however, and the nation had long disappeared from its strongholds when the fountain-heads had almost entirely ceased to flow.

The Pueblo tribes of to-day are but scantily supplied with

water. In the vicinity of each town one or two small, brackish springs may exist, and these usually at the foot of the bluff, so that the labor of carrying water from the reservoirs, several hundred feet below, to the houses above occupies much time, while the liquid is highly prized and never wasted. I think this scarcity of water originated the custom of performing ablutions in water mixed with saliva and spirted from the mouth over arms and hands, and also that custom which prevails among the women, of using their saliva for mixing clay, both in plastering the walls of the houses and frequently in making potter's clay.

The Moqui people are dwindling away year by year. In the last twenty years they have decreased from six thousand to fifteen hundred, while the Pueblo and Zuñi tribes are just as surely dying out. In a short time they will have entirely disappeared, and their deserted towns will form other groups among the ruins which now dot the desert of the far Southwest.

THE AMERICAN ANTELOPE.

BY S. W. WILLISTON.

THE great plains of the West have afforded to sportsmen and tourists few more attractive features than the American or prong-horned antelope (*Antilocapra Americana*). While their habitat embraces a large range of country, extending from the Missouri River nearly to the Pacific slope, the region that is most peculiarly their home is the vast untimbered prairies of Kansas, Colorado, and Nebraska, where they have so long been associated with the other mammals so characteristic of those arid plains, — the buffalo and prairie-dog.

Since my early childhood their graceful forms and timid, startled movements have been to me familiar sights upon the Kansas prairies, and for several summers they have been daily, almost hourly, objects of my admiration.

Their peculiar habits necessarily prevent their remaining in settled regions. Unlike the deer family that find shelter in forests or rocky ravines, away from the observation of their enemies, the prong-horns seek the most conspicuous localities on the tops of hills and divides, or at the heads of ravines and the smaller water-courses, where their almost wonderful vigilance readily warns them of the approach of danger. The power of sight and the extreme wariness which these animals possess fill

even the experienced observer with fresh surprise, and the inexperienced sportsman with chagrin. The horseman riding over the trackless wilds of Western Kansas or Colorado is constantly observing, far away on the horizon, mere specks of moving life bounding away with more than the fleetness of the greyhound, till in a few moments they are lost to his gaze. Their watchful attention, ever on the alert, will notice the approach of an unusual object even before they themselves are distinguishable from the surrounding prairies. Unlike the buffalo, whose power of sight is comparatively feeble, but which will scent danger from a very great distance, the antelopes depend almost exclusively upon their acute vision for safety. I have frequently watched them, from some sheltered spot near at hand, while they have been quietly grazing: with almost every mouthful of food, cropped from the short, crisp, nutritious buffalo grass that they like so well, the suspicious animals raise their heads erect and gaze about them. This is especially true of the male, he being most frequently the first to apprise a herd of danger; he also possesses more of that curiosity that so often proves fatal. These animals, however, readily become accustomed to even the strangest objects if stationary or permanent. They will often graze quietly within a few hundred yards of a railroad station, nor even show very much fear at passing trains; but their timidity at the approach of human beings is rarely lessened. Their instinct has taught them that man is their worst enemy.

Their long association with the buffalo, of which they have not the slightest fear, renders them indifferent to the presence of domesticated cattle, with which they will mingle freely, feeding quietly side by side. It is in such cases that the hunter can approach them most easily, as they lose much of their habitual watchfulness when in large herds, whether of their own kind, or of buffaloes, or cattle. A friend — a cattle owner on the plains — gives an account of a male which became so attached to a herd of cattle that he seldom left them, and for nearly three months allowed himself to be driven about with his new-found companions, showing his instinctive timidity only at the approach of a strange herder. He finally abandoned the herd when driven to a new pasture ground.

Although so very timid in the feral state, they may be tamed with the utmost facility, evincing an unusual degree of affection for their master, or more especially their mistress. The great delicacy of their flesh as food, together with the hardiness the

animals exhibit in a wild state, renders the question an interesting one, whether the antelope might not be advantageously added to the list of domesticated animals.

When quite young, or for a few weeks or so after birth, the "kids"[1] show a strange lack of fear, and, if approached gently while lying down, will allow themselves to be caught without resisting, and after a few plaintive bleats and a little caressing will often follow their captor, nor permit themselves to be eluded! The young, which are dropped between the 15th or 16th of May and the first week in June, are almost invariably twins. For a short time previous to their birth, the doe, absenting herself from her companions, seeks a somewhat secluded spot near the head of a ravine, where her kids remain for a few days, till they attain sufficient strength of limb to keep pace with the adults. The kids are very playful, and there are few more pleasing sights presented by mammals than the gambols of these beautiful little creatures as they leap about and push each other, occasionally making their sedate mother an unwilling party in their sports. The doe frequently leaves them to graze a mile or two distant, and the kids when tired of playing with each other will find imaginary playfellows in clumps of grass or tall weeds. The friend previously spoken of relates an incident that is worthy of reproduction here. One day, leaving two quite young calves in a secluded spot, and returning in an hour or two, he was amused upon nearing them to find a doe complacently looking on while her young kids, having induced the calves to become their willing playmates, were gayly frolicking with their new acquaintances.

The young very soon attain their full stature, and by the following December are scarcely distinguishable from the adult. It is very rare that a non-pregnant female is shot in the spring, and there is but little doubt that the antelope breeds at the end of the first year. The period of gestation is apparently a little more than eight months.

From early spring till September herds embracing more than a dozen individuals are seldom seen — the males usually keeping more or less isolated. They feed upon the uplands during the day, approaching the water-courses or standing pools only later in the afternoon. At night their favorite resorts are near the heads of ravines or other secluded spots, and they frequently lie in the morning till the sun is some distance above the horizon.

[1] I use the terms, as applied by hunters and sportsmen, of "buck," "doe," and "kid," although evidently incongruous.

The bucks, and, in a less degree, the does also, possess a singular amount of curiosity strangely at variance with their habitual timidity. Any slowly moving or obscure object when seen at a short distance, for the first time, will almost invariably command their instant attention, rendering them undecided and bewildered. Either by moving from side to side in a quick startled manner, or by standing perfectly motionless with head highly erect, at the same time repeating their peculiar shrill snort or whistle, they exhibit a ludicrous mingling of fear and inquisitiveness. So long as the object keeps in sight they continue to approach, often to within a few rods; but the moment they are fully satisfied of danger, or the object disappears, they are off with the fleetness of the wind, not often stopping till one or two miles are between them and the danger. The hunter frequently takes advantage of this trait to allure his game within easy range. A fluttering cloth, the barrel of his rifle, or the hunter's heels, as he lies upon the ground, are often sufficient to attract them. One of my first experiences in hunting these animals has ever since afforded me amusement. Starting a small herd one evening, and not knowing how useless the attempt would be to follow them, I set out in pursuit. On seeing them go over the brow of a neighboring hill, I crept cautiously for several hundred yards till I reached its summit. Then rising to my feet I was myself startled by a shrill snort immediately behind me, and turning about perceived the animals gazing at me in intense astonishment but eight or ten rods away. They must have followed me for nearly a quarter of a mile as I crept along in the early dusk.

When wounded and brought to bay they rarely evince any pugnacity,—in singular contrast with the mule deer (*Cervus macrotis*) of the same regions. I have known a buck when disabled and caught to stand bleating piteously while its throat was cut. Occasionally, however, they will turn and fight with desperation, using both their feet and horns.

In the regions where they abound they decrease slowly by reason of their enemies. They are difficult game even to the professional hunter, and certainly not many fall victims to the wolves. Several times I have watched the attempts of coyotes to prey upon them, but never with success. The wolves crawling through the grass attempt to seize their victims by stealth, for, notwithstanding Mark Twain's very graphic description of the speed of the coyotes, they are hardly a match for the antelopes. The warning snort of a buck quickly brings the herd compactly

together upon some eminence, when the males gathered about watch sharply the movements of their enemy; when closely pressed they take refuge in flight.

There has been much dispute as to whether the male antelope habitually sheds his horns. The weight of evidence is strongly in favor of it; but I should hesitate before positively affirming it myself. At all events the new horns must attain their strength and size *very* soon after the disappearance of the former ones. A female is occasionally shot having a remarkable development of rudimentary horns; in one instance, a doe with kids had horns that measured four inches, with the prongs proportionately developed. Their horns are, however, soft and pliable, with the rudimentary horn-core but little if any developed.

In conclusion, I would call the attention of naturalists to the importance of securing legal protection for this, one of the most interesting of all American mammals, that it may not share the fate that is fast overtaking the buffalo. The antelope can never exist in even a moderately inhabited country. The vast unproductive region of Western Kansas and Eastern Colorado will be its home so long as this region remains comparatively unsettled, provided suitable legislation can be effected in its favor.

ON THE LAWS OF DIGITAL REDUCTION.

BY JOHN A. RYDER.

AT a recent meeting of the Philadelphia Academy I called attention to several facts bearing upon an explanation of digital reduction. It was suggested that the fact of the number of toes being least wherever mechanical strains were greatest and impacts most frequent and most severe might be regarded as an effect of such increased intensity of strains. To make this conclusion appear valid it was only necessary to refer to the foot-structure of the different orders of the class of mammals.

It may be observed that among the primates the only creature having any one toe greatly augmented in size and strength is man; here it is the great one, or the first of anatomists. Its whole structure, especially the articulation with the carpus, calls to mind the condition of things found to exist in the groups which have undergone the most modification in the structure of the feet, namely, the ungulates or hoofed animals, kangaroos, and jumping mice. The calibre of its distal elements is greatly in-

creased, while the ento-cuneiform and navicular are greatly flattened or modified in the same way as the magnum and unciform of the manus and the middle and ecto-cuneiforms of the pes are in many ungulates, or as is the cuboid in the kangaroos.

In ungulates the third and fourth toes become functional, the second and fifth either disappearing or else assuming the office of lateral supports. In the jumping mice (*Dipodidæ*) the second, third, and fourth of the hind feet are the functional ones; in one species three toes are all that remain; in another with four the fifth, a rudimentary one, does not reach the earth; and in another species with five the first and fifth toes are rudimentary. In these three animals, then, of one family and only generically separable by the difference in the number of toes, we have a case in living animals resembling the "demonstrative evidence" of Professor Huxley drawn from fossil horses' toes, which so far as the necessity for time is concerned shows that creatures of almost identically the same habits and structure may be cotemporaneous, yet differing widely in the number and length of the hind toes. It indicates, it seems to us, that toe modification goes on at greatly varying rates. In the kangaroos the fourth and fifth toes of the hind foot are most strongly developed, while the second and third are atrophied and used only to cleanse the fur. It may be noted here, also, that the toes of the fore foot of the kangaroo remain entirely unmodified, and much the same as is the case in the jumping mice, for the reason that the strains are more equally distributed.

The *Chrysochloris* amongst moles offers an instance where the digital reduction has taken place in the anterior extremity, where also the mechanical strains are most frequent and severe. The same fact is observed in *Cyclothurus*, a little South American arboreal ant-eater, where but two functional toes remain upon the fore foot. In the great ant-bear (*Myrmecophaga*), the third digit of the manus is the strongest, the others evidently undergoing reduction, while the former is being constantly augmented by the strains to which it is subjected in obtaining insect prey.

The sloths of both recent and extinct groups furnish an instance where the number of toes has been reduced from the typical number five to as few as two in one pair of extremities in the living *Cholœpus*. The digits also in recent species are of about equal length, which cannot be said of the extinct terrestrial species, where in some cases (*Mylodon* and *Megalonyx*) considera-

ble inequality existed. The equality in existing species is no doubt due to the equality of tractile strains upon each one of the digits, owing to the peculiar method of climbing and hanging to the limbs of trees by the great hook-like claws.

The frequent reduction in the number of toes in the foot before it commences in the hand is seen in the carnivorous groups *Felidæ* (cats) and *Canidæ* (dogs), in odd-toed ungulates, in the swift-foot terrestrial *Rodentia*, and universally amongst such animals as perform locomotion entirely by leaping with the hind feet, as the kangaroos and jumping mice. Upon this point it may be observed that these creatures all more or less decidedly leap, or else pitch the body through space in running, mainly by means of the hind limbs. The effect of this unequal distribution of strains has shown itself in the hypertrophy of certain digits and their consequent specialization at the expense of the atrophy of the others. The direction in which growth force is manifested is here determined, as it is determined in all kinds of work or exercise, by the increased development of parts most exercised, and shows that the claims of a certain surgeon, who is said to have been able to tell the occupations of tradesmen by inspecting the development of the muscles upon the body are not without foundation. Two cases of this kind have fallen under my own observation, one in the person of a carpenter and another in that of a blacksmith.

It may be well to note in this place that man, the only *primate* whose feet serve exclusively for purposes of locomotion, belongs to the foregoing class. The outer toes in man are weaker, shorter, and less developed than in any of the higher apes, and what may eventually be the fate of these outer toes, if, as many do, he keeps on wearing shoes that a savage would not wear for a single hour, combined with the structure now admirably conditioning a gradual reduction, only our descendants will be able to determine a thousand years hence.

The lines of bones through which strains have been directed are in some way determined by the uses which the feet serve in the life of the animal and its ancestral series. This is supported by the fact that where the strains to be overcome are equally distributed amongst all the digits there is rarely any specialization of toes. In aquatic, marine, and arboreal animals the distribution of strains is comparatively equal, and I now call to mind but a very few exceptions to this rule, which is but slightly affected by even these. One case is the *Cyclothurus*, where, however, the hind foot and tail are modified into grasping organs,

leaving the great pair of claws in front for the purpose of tearing up the bark and getting into crevices in searching for insects. The *Dendrolagus* or tree kangaroo is another instance, but here the descent from the terrestrial kangaroos is too obvious to require discussion. In studying the fossil kangaroos Professor Owen noticed that the fur-claws were not as rudimentary as in the living species, showing that at one time there was a more uniform distribution of strains than now.

Among fossorial animals it is usual to find the claws and toes well developed upon the fore limbs; this is so in the moles, armadillos, recent and fossil, and in the *Geomyidæ*, or gophers, where the distribution of strains is very unequal in respect to the fore and hind pairs of limbs. So, too, in the group in which man has been included, where the strains are greatest upon the hind pair, as in animals that run rapidly or are capable of making great leaps, like dogs, cats, rabbits, tapirs, cavies, or guinea pigs.

It seems to us the most convincing proof of the doctrine of descent to find man an instance of the same kind of specialization determined by the manner of the distribution of strains as is so often found among the lower groups, such as the horses, sloths, jumping mice, and even-toed ungulates. We would not put him in respect to foot-structure among the true plantigrades, for unlike them the elements of the digits are not uniformly of the same strength and calibre. He might be somewhat clumsily called an inequidigitate plantigrade.

Now as to the osteological side of the question: in man the bones through which the line of greatest mechanical strain passes are the first digit, ento-cuneiform, navicular, calcaneum, and astragalus. In the horse this line passes through the third digit, external cuneiform, navicular, astragalus, and calcaneum in the hind foot; through the third digit, magnum, scaphoid, and lunar in the fore foot. In the kangaroo through the fifth, but mainly through the fourth digit, the cuboid, calcaneum, and astragalus in the hind foot. It will be noticed also that in the highest member of the highest group it is the first digit that is specialized; in the intermediate groups that the intermediate digits are specialized; that next to the very lowest group it is the fourth digit; and, further, that there are corresponding chains of specialized bones which receive and distribute the strains.[1]

[1] It may be as well to note that birds belong in the category of types which have undergone digital reduction. The ostrich for obvious reasons is the extreme. Among reptiles, turtles and dinosaurs may be included, both of which stand near the birds in the system.

The following summary and conclusions are offered: —

I. That the mechanical force used in locomotion during the struggle for existence has determined the digits which are now performing the pedal function in such groups as have undergone digital reduction.

II. That where the distribution of mechanical strains has been alike upon all the digits of the manus or pes, or both, they have remained in a state of approximate uniformity of development.

III. It is held that these views are Lamarkian and not Darwinian, that is, that they more especially take cognizance of mechanical forces as mutating factors in evolution, in accordance with the doctrine of the correlation of forces.

ON THE DISTRIBUTION OF FRESH-WATER FISHES.

BY DAVID S. JORDAN.

THE writer has been engaged during the two past summers (1876–1877) in collecting fishes in the upper waters of the different river basins in the Southern States, with a view to ascertaining the fish fauna of each and to throw as much light as possible on the laws which govern the distribution of the species. In 1868 and 1869, Professor Cope made very thorough explorations of the upper waters of the Cumberland, Tennessee, Kanawha, James, Roanoke, Neuse, Great Pedee, and Santee. In order to supplement Professor Cope's work, the writer, with his ichthyological assistants, Prof. A. W. Brayton and Mr. C. H. Gilbert, began with the Santee, and proceeded westward across the different river basins, including the Santee, Savannah, Oconee, Ocmulgee, Chattahoochee, Alabama, Tennessee, Cumberland, and Ohio. These rivers, as well as those examined by Professor Cope, have their rise in the Alleghany Mountains, from which they flow in different directions and under the most widely varied physical conditions, thus affording the most favorable opportunity for the study of the effect of these conditions on the distribution of fishes.

Some forty-three species new to science were obtained by us in these Southern rivers, among them several singular and interesting forms, but of these I do not purpose to speak at present. I shall confine myself to the statement of a number of propositions — apparently truths — in regard to the distribution of

fishes, which have been drawn from my own experience as a collector. In these, I have had reference chiefly to the smaller or non-migratory species, the *Centrarchidæ*, *Etheostomatidæ*, and *Cyprinidæ*. The larger species are generally too little known or are too widely distributed to be especially considered here.

The theoretical questions of how fishes have become dispersed, or how and why they have in past time extended their range, I do not propose to discuss. These points and others noticed below have been ably treated by Professor Cope.[1]

It may be premised that some of the propositions contained in the following pages are probably only half truths, to be more completely stated as our knowledge increases.

I. In the case of rivers flowing into the *ocean* the character of the faunæ of the upper waters compared one with another bears no or very little relation with the places of discharge. An illustration of this may be taken in the general similarity of the faunæ of the Youghiogheny and Upper Potomac rivers, — or in the greater resemblance existing between the faunæ of the Chattahoochee and Ocmulgee than between those of the Chattahoochee and Alabama. The Wisconsin River and the Red River of the north have a very similar fauna.

II. River basins having a similar discharge into some larger river or lake have a similarity of fauna due to this fact, and in general, other things being equal, the nearer the points of discharge, if in *fresh water*, the greater the resemblance. The almost identical fauna of the Catawba and Saluda will exemplify this.

III. The higher or the older the water-shed between two rivers, the fewer species are common to both. (This needs further investigation.)

IV. Certain species — not including "species of general distribution" — occur on opposite sides of even the highest water-sheds. This fact was first noticed by Professor Cope. The occurrence of *Luxilus coccogenis* and *Hybopsis rubricroceus* in the Tallulah and Little Tennessee rivers will illustrate. Neither species is known as yet from any river basin other than the Savannah and Tennessee. The existence of *Platygobis gracilis* in the upper waters of the Missouri and Colorado is another illustration.

V. When the water-shed between two streams is a swampy upland instead of a mountain range, the same species will be

[1] Journal Acad. Nat. Sci., Phila., 1868, pp. 239–247.

found in the head waters of both, although the faunæ of the lower courses may be different. In case the one stream flows northward and the other southward, the common fauna will be essentially that of the northernmost stream.

In Northern Indiana, the same species occur in the head waters of the St. Joseph's, Maumee, Wabash, and Illinois rivers, although these streams discharge their waters in widely different directions. This is accounted for in the fact that the swampy waters-shed is often overflowed, affording in the spring an easy water communication.

VI. Many species inhabiting small tributaries of any river are different from those abounding in the river channels. This fact is well known.

Among the brook species may be enumerated *Eucalia inconstans*, *Chrosomus erythrogaster*, *Pœcilichthys spectabilis*, *Xenotis lythrochloris*, *Semotilus corporalis*, *Xenisma stellifera*, *Salmo fontinalis*, the species of *Rhinichthys*, etc., etc. Of the channel species, such as *Hyodon*, *Haploidonotus*, *Dorysoma*, *Pomolobus*, *Roccus*, all the buffalo-fishes and the larger cat-fishes, *Ichthælurus punctatus*, *Pelodichthys olivaris*, *Amiurus nigricans*, and the like will serve as examples.

VII. Many species inhabiting the upper course of a stream are different from those of the lower. This subject has been well discussed by Professor Cope,[1] but further investigations, especially of the rivers of the Southern States, are much to be desired.

VIII. This difference in the upper and lower faunæ is due chiefly to differences in physical conditions of either water, river-bed, food, or climate.

IX. Hence, if in the same river basin there are two streams flowing into the larger stream, the one near the source, the other near its mouth, and these two streams are similar in all known physical respects, their faunæ will be similar, and if dissimilar they will have different faunæ. The general identity of the fishes of Elk River in Western Tennessee and those of Powell's River may be noticed in this connection.

X. Some species of fishes are confined strictly to a single river basin, while others, with apparently no better means of defense or of diffusion, are widely distributed, inhabiting many rivers. In illustration of this the narrow range of each of the colored species referred to *Photogenis* may be compared with the range of *Luxilus cornutus*, which extends from Maine to Arkansas and Montana.

[1] Loco citato.

In the genus *Nocomis* (*Ceratichthys* Baird) *N. biguttatus* probably occurs in every river from Pennsylvania to the Great Salt Lake, while four species of the same genus, *N. micropogon*, *N. monachus*, *N. zanemus*, and *N. labrosus*, are each, so far as is known, confined to a single river basin.

XI. In any river basin the most abundant species (of small fishes) are usually (*a*) those peculiar to it, or some of them; or (*b*) those of the widest distribution. In illustration of this we may notice the abundance of "*Photogenis*" *pyrrhomelas* and *Nototropis photogenis* in the Santee; of "*Photogenis*" *stigmaturus* and *Luxilus cornutus* in the Alabama; of "*Photogenis*" *eurystomus* and *Nocomis biguttatus* in the Chattahoochee; of "*Photogenis*" *xænurus* and *Notemigonus Americanus* in the Ocmulgee. To this rule, however, there are many exceptions and modifications.

XII. In general, the further south any river basin lies, the more species are peculiar to it and the greater the difference between its fauna and that of the neighboring streams. In illustration of this, the differences existing between the faunæ of the Alabama and Chattahoochee may be compared with those between the Susquehanna and the Delaware. Twelve genera are known as common to the Alabama and Chattahoochee, twenty-three to the Susquehanna and Delaware. In the Southern streams, the process of evolution of specific forms seems to have progressed more rapidly.

XIII. Species of the widest distribution often have breaks in their range which cannot be accounted for by any facts now in our possession. *Luxilus cornutus*, — the common shiner or red-fin of New England, — so abundant in all the rivers of the North and West, does not occur, so far as is known, in any of the rivers between the Neuse and the Alabama, in both of which streams it is very numerous. Various other species range over several river basins and then cease abruptly. *Amuirus brunneus* is the most abundant food-fish in the rivers from the Santee to the Chattahoochee, while in the next river westward — the Alabama — it is unknown.

XIV. Many species of wide distribution which are absent in certain streams are there represented by certain other related species which may be regarded as modified descendants. Thus, in the South Atlantic streams, *Chænobryttus gulosus* is represented by *Chænobryttus viridis*, *Notemigonus chrysoleucus* by *Notemigonus Americanus*, etc. In the Southwest, *Eupomotis aureus* is

represented by *Eupomotis pallidus*. In the West, *Noturus gyrinus* by *Noturus sialis*, *Noturus insignis* by *Noturus exilis*, *Umbra pygmæa* by *Umbra limi*.

XV. Other species under similar circumstances have no such "representatives." The case of *Luxilus cornutus* will again illustrate.

XVI. Certain species have been known to extend their geographical range since the opening of the canals. Such are more especially migratory species of probably marine origin, as, for example, *Dorysoma heterura*, *Pomolobus chrysochloris*, and *Anguilla vulgaris*, now abundant in Lake Erie and Lake Michigan, but formerly unknown there. The range of certain *Percidæ* and *Centrarchidæ* has been extended by the same means.

XVII. Rivers flowing parallel into the same larger stream have more in common than rivers having their mouths nearer together but flowing from opposite directions. The Wabash and Miami have more in common than either has with the Kentucky.

XVIII. The characteristically American forms of fishes are, generally speaking, rare or absent in the waters of New England and of the Pacific slope. This fact has been apprehended by Professor Agassiz, who called New England "a zoölogical island."

About one hundred and five genera of fresh-water fishes inhabit the waters of the United States, east of the Mississippi River. Of these, the following seventy-seven do not occur in New England (exclusive of Lake Champlain and tributaries of the St. Lawrence): —

Potamocottus,	Stizostethium,	Typhlichthys,	Gila,
Cottopsis,	Micropterus,	Chologaster,	Nocomis,
Triglopsis,	Ambloplites,	Astyanax,	Ericymba,
Ammocrypta,	Acantharchus,	Percopsis,	Exoglossum,
Pleurolepis,	Chænobryttus,	Thymallus,	Lagochila,
Percina,	Apomotis,	Hyodon,	Placopharynx,
Alvordius,	Xenotis,	Campostoma,	Myxostoma,
Ericosma,	Xystroplites,	Hybognathus,	Cycleptus,
Hadropterus,	Mesogonistius,	Pimephales,	Carpiodes,
Imostoma,	Hemioplites,	Hyborhynchus,	Ichthyobus,
Rheocrypta,	Copelandia,	Hybopsis,	Bubalichthys,
Ulocentra (Jor. MSS.),	Centrarchus,	Lythrurus,	Ichthælurus,
	Pomoxys,	Cyprinella,	Pelodichthys,
Diplesium,	Haploidonotus,	Erogalia (Jor. MSS.),	Noturus,
Nanostoma,	Aphododerus,		Amia,

Nothonotus,	Eucalia,	Nototropis,	Lepidosteus,
Pœcilichthys,	Labidesthes,	Cliola,	Litholepis,
Etheostoma,	Xenisma,	Phenacobius,	Polyodon,
Microperca,	Zygonectes,	Chrosomus,	Scaphirhynchops.
Elassoma,	Amblyopsis,	Phoxinus,	

Of the genera found in New England, only *Salmo*, *Esox*, *Rhinichthys*, and perhaps *Amiurus* are represented by more than one species. From thirty to thirty-five genera occur in the waters of the Pacific slope.

XIX. The larger the river basin, the greater its variety of forms, — both generic and specific. Compare the number of species inhabiting any of the tributaries of the Mississippi with those of any eastern river. Seventy species have been taken in the little White River at Indianapolis, representing forty-eight genera, twice as many as occur in all the rivers of New England.

XX. Other things being equal, a river whose course lies in a region of undisturbed stratified rocks or of glacial drift contains most genera and species.

XXI. Conversely, rivers whose courses lie over igneous or metamorphic rocks contain fewest species. Such rivers often contain great numbers of individuals.

XXII. Sources of streams on opposite sides of a high watershed often have species in common which do not occur in the lower courses of the same rivers. Some mountain species, as *Salmo fontinalis* and *Hybopsis rubricroceus*, exemplify this.

XXIII. Certain species have a compact geographical range, occurring in all waters within this range, without apparent regard to the direction of their flow. Such are *Lepiopomus obscurus*, in the Alabama, Tennessee, and Cumberland, and *Hybopsis microstomus* in the James, Roanoke, Kentucky, Cumberland, and Clinch.

XXIV. Certain species have a wide east and west range, apparently regardless of the course of the rivers, but are bounded on the north or south by parallels of latitude.

Eucalia inconstans is found from Western New York to Kansas, and northward — but never southward — of a line passing about fifty miles south of Lake Erie. *Percopsis guttatus* has a like range, but its southern boundary is in the Potomac and Ohio. *Lota lacustris* is similarly circumscribed. The three species of *Lythrurus* have each a belt of latitude, — *L. cyanocephalus* belonging to the Great Lakes and Upper Mississippi, *L. diplæ-*

mius to the Ohio and Potomac, *L. ardens* to the Cumberland, Roanoke, and James.

XXV. Certain species have a peculiar northern and eastern range, occurring in the Upper Mississippi, in the head waters of the Illinois, Wabash, and Scioto, thence through the Great Lakes and New England, thence to South Carolina on the eastern slope of the Alleghanies. Such are *Perca Americana*, *Eupomotis aureus*, and *Amiurus catus*.

XXVI. Certain species have a peculiar northern and western range, occurring in the Middle States and in the Great Lakes and usually southward in the east to some point in Virginia or North Carolina, ceasing in the same latitude on both sides of the Alleghanies, but extending southwestward through the Mississippi Valley to the Gulf. Among these may be mentioned *Luxilus cornutus*, *Notemigonus chrysoleucus*, *Ambloplites rupestris*, *Apomotis cyanellus*. The last-named species, however, scarcely extends east of the Alleghanies.

XXVII. Certain species have a wide range north and south, either east or west of the Alleghanies, which do not cross that chain. Of these may be mentioned *Lepiopomus auritus*, *Enneacanthus obesus*, *Aphododerus Sayanus*, *Esox reticulatus*, etc., on the east, and *Haploidonotus grunniens*, *Hyodon tergisus*, *Noturus miurus*, *Noturus sialis*, etc., on the west.

XXVIII. The distribution of fresh-water fishes is dependent on (*a*) fresh-water communication; on (*b*) character of stream, that is, of water, as to purity, depth, rapidity, vegetable growth, etc.; on (*c*) the character of the river bed, as to size, condition, of bottom, etc.; on (*d*) climate, as determined by latitude and by elevation above the sea; and finally on (*e*) various unknown factors arising from the nature or the past history of the species in question, or from the geological history of the rivers.

RECENT LITERATURE.

American Insectivorous Mammals. — Dr. Coues has recently published a preliminary paper on the American Insectivora,[1] in which are described three new subgenera and five new species of *Soricidæ*.

[1] *Precursory Notes on American Insectivorous Mammals, with Descriptions of New Species.* By Elliott Coues. Captain and Assistant Surgeon United States Army, Secretary and Naturalist of the Survey. Bulletin U. S. Geology and Geographical Survey, vol. iii. No. 3, pp. 631, 653. Department of the Interior: Washington. May 15, 1877.

The new subgenera are *Soriciscus* (subgenus of *Blarina*), *Microsorex* and *Notiosorex* (subgenus of *Sorex*). Four of the new species belong to the genus *Sorex* and the other to *Blarina*. This paper forms the first general notice of the genera and species of the American moles and shrews that has appeared since the publication of Professor Baird's well-known work on the Mammals of North America, in 1857 — twenty years ago. Much material has in the meantime accumulated, which shows that the number of species then admitted "require to be largely reduced," while others must be added, based on material since collected; but all the generic and subgeneric distinctions pointed out by Professor Baird "are confirmed." In 1861, according to Dr. Coues, Professor Baird again reviewed the subject, "making new and important determinations, which, however, have never been published." Many of these are inedited from Professor Baird's MSS.

In these "Notes," which are "to be considered as preliminary to a monograph of the American Insectivora, now in preparation," Dr. Coues recognizes four genera of moles (*Talpidæ*), namely *Scalops*, *Scapanus*, *Condylura*, and *Urotrichus;* the last common to Western North America and Asia, the others strictly American. These are each represented by a single species, except *Scapanus*, which has two, the one (*S. Breweri*) eastern, the other (*S. Townsendi*) western. The *Scalops argentatus* of Audubon and Bachman (and also of Baird) is considered as merely a geographical race of the common eastern *S. aquaticus*.

Of the shrews (*Soricidæ*), no formal list of species is given, but the genera and subgenera are discussed and characterized in detail, and their distribution is quite fully indicated. The genera and subgenera recognized are as follows: 1. *Neosorex;* 2. *Sorex*, embracing subgenera, (*a*) *Sorex*, (*b*) *Microsorex* (Baird, MSS.) (*c*) *Notiosorex* (Baird, MSS.); 3. *Blarina*, embracing the subgenera (*a*) *Blarina*, (*b*) *Soriciscus* (Coues). The genus *Sorex* alone occurs in the higher latitudes, where it is mainly represented by the subgenera *Sorex* and *Microsorex*, the latter having been recently ascertained to extend to the region of the Yukon River. In the high north the species are few, but the individuals are numerous, being comparable in point of number with the arvicolas and lemmings. *Sorex* proper occurs also throughout the whole of the United States, and is represented farther southward, in Mexico and Central American, by Coues's new subgenus *Notiosorex*. Near the northern boundary of the United States the species of shrews greatly increase in number; where we first meet with the genera *Neosorex* and *Blarina*, the latter being the most characteristic American genus of the family. *Neosorex* occupies a belt across the middle of the continent, from Nova Scotia and New England to Oregon and Washington Territory, and extends southward in the Rocky Mountains to New Mexico. *Blarina* extends far southward, but is represented in Mexico and Central America by only the subgenus *Soriciscus*, and has not yet been met with west of the Rocky Mount-

ains. The shrews are represented by the greatest number of species in the United States; none occur in South America, where also the moles are apparently absent.

The new species described are (1.) *Sorex pacificus* (Baird, MSS. ined.), from Fort Umpqua, Oregon; (2) *Sorex sphagnicola*, from Fort Liard (or vicinity) H. B. T; (3) *Sorex* (*Notiosorex*) *Crawfordi* (Baird, MSS. ined.), from near Fort Bliss, New Mexico; (4) *Sorex* (*Notiosorex*) *evotis*, from Mazatlan, Mexico; (5) *Blarina* (*Soriciscus*) *Mexicana* (Baird, MSS. ined.), from Xalapa, Mexico.

Recent Ornithological Papers. — Among the many faunal lists of birds that have appeared so frequently during the last few years, none exceed in interest Mr. E. W. Nelson's recently published catalogue of the Birds of Northeastern Illinois.[1] The locality, owing to certain topographic l peculiarities, is of a somewhat exceptional character. Its position, midway between the wooded region of the East and the treeless plains of the West, with the Great Lakes in close proximity, and warm river-bottoms extending up from the South, renders it, as Dr. Hoy long since termed the contiguous portions of Wisconsin, a kind of "four corners," where the bird faunas of four regions to some degree interblend. In summer some twenty species, characteristic of more southern latitudes, find here their northern limit of distribution, extending considerably further north here than on the Atlantic coast or in the intervening region. A dozen other species whose proper homes have been considered to be the region west of the Mississippi River or the great plains, still further west, have also been detected as casual visitants. Lake Michigan, with the chain of Great Lakes to the eastward, affords conditions favorable to the development of a decidedly maritime element in the fauna, through the occasional presence in or about its waters of most of the so-called sea-ducks and gulls, as the three species of scoter (*Œdemia*), two species of eider (*Somateria*), the harlequin and the oldwife ducks, and the skua, glaucus, white-winged, black-backed, and kittiwake gulls; and, among shore-birds, such species as the sanderling, the piping plover, and several sandpipers usually regarded as maritime. More unexpected, perhaps, than any of these is the sharp-tailed finch (*Ammodromus caudacutus*), known previously only as an inhabitant of the salt-marshes of the Atlantic coast. In the marshes of Northeastern Illinois, however, it takes on a slightly different phase of coloration, and has become otherwise so far modified as to be recognizable as a distinct race (var. *Nelsoni*), which has been honored with the name of its discoverer.

Mr. Nelson has recorded three hundred and sixteen species, with several additional varieties, as found within the limited area of scarcely more than two counties (Cook and Lake), a considerably larger num-

[1] *Birds of Northeastern Illinois.* By E. W. Nelson. Bulletin of the Essex Institute, vol. viii., pp. 90–155, April, 1877.

ber than has been recorded from any other locality of equal extent in the United States. While this large number shows the thoroughness with which Mr. Nelson has performed his work, this alone but imperfectly indicates the value of his paper, which embraces not only the usual notes respecting the times of migration, nesting, and relative abundance of each species, but here and there important additions to the biographies of hitherto little-known species, including accounts of the songs of several species not before described, and the nests and eggs of others, and their breeding habits. Particularly noteworthy is the discovery of the nest and eggs, in Illinois, of several species previously supposed to nest only in much higher latitudes, one of these being the greater yellow-legs (*Totanus melanoleucus*). Among the curious things recorded is the nesting of the qua-bird or night heron *on the ground* in the Calumet Marshes, the nests being placed in dense clumps of wild rice. The paper is written clearly and concisely, and nowhere contains redundant matter.

Since the publication of Mr. Nelson's above-noticed paper on the Birds of Northeastern Illinois, he has given us further information respecting the birds of Southern Illinois.[1] This paper contains notes on one hundred and thirty-three species, based on observations made at several different localities, embracing the vicinity of Mount Carmel, Fox Prairie in Richland County, Anna in Union County, and the vicinity of Cairo. It contains much information relating to the distribution of the summer birds of the region treated, and here and there interesting biographical notes concerning imperfectly known species.

Respecting a more southern locality we have an important paper by Lieut. C. A. H. McCauley [2] on the ornithology of that portion of Texas near the source of the Red River. This paper, containing notices of about one hundred species, is particularly welcome as throwing much light upon a region hitherto ornithologically little known. Although based on the observations of a few months in summer, it comprises much valuable matter, relating especially to the distribution and habits of the species met with. Here, as generally on the treeless plains of the interior, few species of birds are found except in the vicinity of the timber-skirted streams, where bird-life is generally abundant. The region reported upon embraces a portion of the so-called Staked Plain or Llano Estacado.

We have received also a Catalogue of the Birds of the Vicinity of Cin-

[1] *Notes upon Birds observed in Southern Illinois between July* 17 *and September* 4, 1875. By E. W. Nelson. Bulletin of the Essex Institute, vol. ix., pp. 32–65, June, 1877.

[2] *Notes on the Ornithology of the Region about the Source of the Red River of Texas.* From Observations made during the Exploration conducted by Lieut. E. H. Ruffner, Corps of Engineers, U. S. A. By C. A. H. McCauley, Lieut. Third U. S. Art. Annotated by Dr. Elliott Coues, U. S. A. Bulletin of the United States Geological and Geographical Survey, vol. iii., pp. 655–695, May 15, 1877.

cinnati, Ohio,[1] by Mr. Frank W. Langdon. This carefully prepared list numbers two hundred and seventy-nine species, nearly all of which are known to have been taken at the locality indicated. The few included on the basis of their general known range are significantly distinguished as being thus included, and embrace only such species as are quite likely to be met with at the locality in question.

A paper on The Summer Birds of the Adirondacks,[2] by Rooseveldt and Minot, forming a list of ninety-seven species, with short notes respecting their relative abundance, gives us our first formal list of the birds of this interesting region.

Among other recent papers relating to American ornithology may be mentioned a paper by Mr. Robert Ridgway, on The Birds of Guadalupe Island, discussed with reference to the present Genesis of Species.[3] This paper deals especially, as its title indicates, with the origin of the few insular forms which make up the avian fauna of this small island, and discusses the relationship of these forms to the birds of the adjacent main-land. The species thus far well known from this island, situated about two hundred and twenty miles southwest from San Diego, number only eight, and their affinities are almost entirely, as would be expected, with those of Western North America. Yet they are so far differentiated from them that they are recognized by Mr. Ridgway as specifically distinct. They all differ somewhat similarly from their nearest main-land allies in three principal features, namely, in (1) "increased size of the bill and feet, (2) shorter wings and tail, and (3) darker colors." These facts point emphatically to the directly modifying influence of the peculiar conditions of environment to which they are subjected, and, taken with other now well-known facts, lead to the conclusion that the present differentiation of species and subspecies is mainly the result of the immediate action of climatic and other surrounding conditions.

In a paper entitled Corrections of Nomenclature in the Genus Siurus,[4] Dr. Coues, after a few preliminary remarks respecting the general subject of nomenclature, shows clearly the necessity for a change of name in two of our three species of wagtail thrushes, and gives an exhaustive table of synonymy for each species.

North American Fur-Bearing Animals. — In the August number of the Naturalist (Vol. ix., p. 505) was printed a circular, prepared by Dr. Elliott Coues, U. S. A., and issued from the Surgeon-General's office, in relation to a work in preparation, to be entitled History of

[1] *A Catalogue of the Birds of the Vicinity of Cincinnati, with Notes.* By Frank W. Langdon. 8vo, pp. 18. Salem, Mass., Naturalist's Agency. 1877.

[2] *The Summer Birds of the Adirondacks in Franklin County, New York.* By Theodore Rooseveldt, Jr., and H. D. Minot. 8vo, pp. 4.

[3] Bulletin of the Nuttall Ornithological Club, vol. xi., pp. 53–58, July, 1877.

[4] Bulletin of the Nuttall Ornithological Club, vol. xi., pp. 29–34, April, 1877.

North American Mammals, to be published by the government. We have before us a "specimen fasciculus" of this work, treating of the family *Mustelidæ* or "fur-bearing animals" of North America.[1]

In point of completeness and thoroughness of elaboration we know of no similar work at all comparable with it. Its scope, so far as the species treated are concerned, is sufficiently indicated by the accompanying transcript of the title-page. In the present short notice it only remains for us to state that while the technicalities of the subject — embracing exhaustive tables of synonymy and bibliographical references, full and discriminating diagnoses of the higher groups as well as of the several species and varieties, the etymology of the various names applied to the genera and species, including the vernacular of various languages as well as the systematic, and the geographical range of each species — are ably handled. There are also added elaborate and detailed biographies of all the American species treated, with shorter and more technical notices of all of their more closely related affines of other parts of the world. Incidentally are given many interesting statistics of the fur-trade, while what we may term the literary history of each species comes in for a large share of attention, and forms by no means one of the least attractive features of the work. The author has drawn from all trustworthy sources of information and has woven into his chapters, with his well-known skill and gracefulness of style, all that is essential to the subject, — all, we might say, that is worth knowing of the animals treated. With this is blended no small amount of information derived by the author from personal observation in the field, with much other matter hitherto either unpublished or concealed in little-known publications. Such special characteristics of the family as the anal glands, which in one group serve so powerfully as an organ of defense, are treated in detail, while the terrible disease known as *rabies mephitica* or hydrophobia from skunk bite receives the full treatment its importance and peculiar interest demand, a dozen pages being devoted to the history of this fruitful source of rabies among dogs and other domestic animals. As a monograph covering the whole field of the popular and technical phases of the subject, it is simply a model of literary workmanship. As nothing of a general character has appeared in the way of a popular history of the mammals of North America for thirty years, or since the publication

[1] *Fur-Bearing Animals.* A Monograph of North American Mustelidæ, in which an account of the Wolverene, the Martens or Sables, the Ermine, the Mink, and various other kinds of Weasels, several species of Skunks, the Badger, the Land and Sea Otters, and numerous exotic allies of these animals, is contributed to the History of North American Mammals. By ELLIOTT COUES, Captain and Assistant Surgeon United States Army, Secretary and Naturalist of the Survey. Illustrated with sixty figures on twenty plates. Department of the Interior, United States Geological Survey of the Territories, F. V. Hayden, United States Geologist. Miscellaneous Publications, No. 8. 8vo. pp. xiv., 348. Washington: Government Printing Office. 1877.

of Audubon and Bachman's great work, — an admirable one for the time but long since rendered antiquated and sadly incomplete through later increase of knowledge, — it is most fortunate that the task of preparing a new history of the subject from the abundant materials now at command has been undertaken by one so thoroughly competent for the task. In the way of unfavorable criticism we have only to add that the plates illustrating the skulls and dentition of the species described are unworthy of the accompanying text. They are referred to as an attempt at delineation by a new process, from which with further experience probably better results may be expected. While the figures are highly useful and fairly expressive, they are artistically harsh and unpleasing. We have as yet evidently no short cut to excellence in the graver's art.

In respect to typography little more could be desired: the type is large and the page open and clear, while careful revision on the part of proof-reader and author is everywhere apparent.

Books and Pamphlets Received. — Ninth Annual Report of the United States Geological and Geographical Survey of the Territories, embracing Colorado and Parts of Adjacent Territories; being a Report of Progress of the Exploration for Year 1875. By F. V. Hayden, United States Geologist. Conducted under the authority of the Secretary of the Interior. Washington: Government Printing Office. 1877. 8vo, pp. 827; 70 plates, 7 maps, and 67 wood-cuts.

Ethnography and Philology of the Hidatsa Indians. By Washington Matthews Assistant Surgeon United States Army. Department of the Interior, United State, Geological and Geographical Survey, F. V. Hayden, United States Geologist in Charge. Miscellaneous Publications, No. 7. Washington: Government Printing Office. 1877. 8vo, pp. vi., 239.

Brehm's Thierleben. Band ii. Heft 5–7. Leipzig. 1877. New York: B. Westermann & Co. 8vo. 40 cents a Heft.

On the Brain of Chimera Monstrosa. By Burt G. Wilder, 1877. 8vo, pp. 32, with a plate. (From the Proceedings of the Academy of Natural Sciences.)

Pacific Coast Lepidoptera. No. 17. On the Transformations of Colias (Meganostoma Reak) Eurydice, Bdv. By Henry Edwards. 8vo, pp. 2. (From the Proceedings of the California Academy of Sciences, 1876.)

Pacific Coast Lepidoptera. No. 18. Description of a N w Species of Heterocampa (Larva and Imago). By Henry Edwards. 8vo, pp. 2. (From the Proceedings of the California Academy of Sciences, October, 1876.)

Pacific Coast Lepidoptera. No. 19. Notes on a Singular Variety of the Larva of Halesedota Agassizii Packd. By Henry Edwards. 8vo, pp. 3. (From the Proceedings of the California Academy of Natural Sciences, November, 1876.)

Pacific Coast Lepidoptera. No. 20. Notes on the Case-Bearing Moths (Psychidæ), with Notices of Californian Species. By Henry Edwards. 8vo, pp. 4, with a plate. (From the Proceedings of the California Academy of Sciences, November, 1876.)

Pacific Coast Lepidoptera. No. 21. Descriptions of Two New Species of the Genus Theda. By Henry Edwards. 8vo, pp. 2. (From the Proceedings of the California Academy of Sciences, December, 1876.)

Pacific Coast Lepidoptera. No. 22. Notes on some Diurnal Lepidoptera, with Descriptions of New Varieties. By Henry Edwards. 8vo, pp. 11. (From the Proceedings of the California Acad my of Sciences, December, 1876.)

Pacific Coast Lepidoptera. No. 23. Description of a New Species of Catocala,

and a List of the California Specimens of the Genus known to occur in Collections. By Henry Edwards. 8vo, pp. 2. (From the Proceedings of the California Academy of Sciences, January, 1877.)

A Partial Synopsis of the Fishes of Upper Georgia, with Supplementary Papers on Fishes of Tennessee, Kentucky, and Indiana. By D. S. Jordan. 8vo, pp. 70. (From the Annals of the New York Lyceum of Natural History, vol. xi.)

Fur-Bearing Animals. By Elliott Coues. 8vo, pp. 348, with 20 plates. U. S. Geological Survey of the Territories, F. V. Hayden, Geologist in Charge, Washington, 1877.

Bulletin of the U. S. National Museum. No. 7. Contributions to the Natural History of the Hawaiian and Fanning Islands and Lower California. By T. H. Streets, M. D., Washington, 1877. 8vo, pp. 166.

Bulletin of the U. S. National Museum. No. 8. Index to the Names which have been applied to the Subdivisions of the Class Brachiopoda. By W. H. Dall. 8vo, pp. 82. Washington, 1877.

Bulletin of the U. S. National Museum. No. 9. Contributions to North American Ichthyology, No. 1. By D. S. Jordan. 8vo, pp. 49. Washington, 1877.

Bulletin of the U. S. Geological and Geographical Survey of the Territories. Vol. iii. No. 4. F. V. Hayden, Geologist in Charge. Washington, 1877. 8vo, pp. 116.

North American Ethnology. Vol. i. By W. H. Dall and G. Gibbs. Large 8vo, pp. 355, with maps and illustrations. U. S. Geological and Geographical Survey of the Rocky Mountain Region. J. W. Powell, Geologist in Charge. Washington, 1877.

Jahres-Bericht des Naturhistorischen Vereins von Wisconsin für das Jahr 1876–1877. Milwaukee, 1877. 8vo, pp. 16,

GENERAL NOTES.

BOTANY.[1]

Gentiana Amarella L. var. acuta (G. acuta Mx.). — While botanizing with Mr. Pringle in Smuggler's Notch, August 9th, we found a small alpine form of this gentian growing abundantly on the sides of one of the steep water-courses that decend from Mt. Mansfield. It is an interesting addition to the flora of New England, and is further indication of the richness of the Notch in boreal plants, to which attention was drawn by Mr. Pringle last year. — C. E. Faxon.

Notes on Some Injurious Fungi, by Professor W. G. Farlow (in Bulletin of the Bussey Institution). — This article is principally devoted to an account of the mold (*Uncinula spiralis* B. and C.) which is common throughout the greater part of the United States. The ripe perithecia have been found from New England to California. The mycelium forms white patches on the leaves and grapes. The conidia which have been known for some time have generally passed for the mold common on European vines (*Oidium Tuckeri*), but it is very doubtful, in spite of their resemblance to one another, whether they are the same thing. The *Uncinula* is more injurious to the grapes than *Peronospora viticola*, as it attacks the berries as well as the leaves. The article contains a few remarks on the vegetable origin of certain

[1] Conducted by Prof. G. L. Goodale.

common knots found on trees. In this connection it is mentioned that the black knot (*Sphæria morbosa*) has been found on the beach plum at Martha's Vineyard.

The New Building for the Kew Herbarium. — In the August number of the *Journal of Botany* is a part of Sir J. D. Hooker's Report for the Year 1876 of the Herbarium of the Royal Gardens at Kew: "The new building for the accommodation of the herbarium is in a very advanced state. It will consist of a hall attached to the back of the present house. The whole of the latter will be preserved except the drawing-room, a single apartment that was added on to its north side, and which has been removed to make room for the new hall, which is eighty-six feet long by forty feet broad, and contains two galleries ten feet broad running round it. The galleries will communicate with each other and with the ground-floor by two circular iron staircases placed one at each end of the building. On each floor there will be an entrance from the old building closed by double iron fire-proof doors. The long sides of the building will be lighted with forty-eight windows, eight on each floor on each side. The cabinets for holding the specimens will be arranged in blocks eight feet high, of two tiers projecting like buttresses between the windows on the ground-floor and galleries, thus accommodating the greatest number of cabinets with the least loss of space, a very important consideration, considering the extent of the collection and the time that would be otherwise lost in consulting it. At the present time the number of cabinets is upwards of six hundred, and the estimated number of specimens contained in the whole is now considerably over a million, reckoning as one all the individuals of the same plant from the same locality."

Botanical Papers in Recent Periodicals. — *Trimen's Journal of Botany*, July, 1877. J. L. Warren, Notes on Some Sussex Plants. E. M. Holmes, The Cryptogamic Flora of Kent (continued in August number). H. F. Hance, On *Sportella*, a New Genus of Rosaceæ (from China). Various short notes and interesting abstracts. August, H. Polakowsky, Catalogue of Costa Rica Plants. R. A. Pryor, On Bobart's Green *Scrophularia* (now identified as a monstrosity of *S. nodosa*). The same writer communicates also a short note on *Carum bulbocastanum*, a list of interesting plants in North Buckinghamshire, England, and an account of *Buxus sempervirens* in the same district. Among the abstracts we find the Report of the Kew Herbarium for 1876 (elsewhere noticed).

Annales des Sciences Naturelles, Botanique, July, 1877. Sorokine, Notes respecting the Vegetable Parasites of *Auguillulæ*. Also, by the same author, Notes in Regard to *Ascomyces polysporus*. Naudin and Radlkofer, The Influence which Changes of Climate have on Plants. Vesque, On the Absorption of Water by Roots, in its Relations to Transpiration.

Flora, No. 19. Professor Julius Klein, Notes on Algæ, continued. No. 21. Arnold, The Mosses of the Jura. Dr. Prantl, On *Hysterium Pinastri* Schr. as a Cause of Leaf Disease in the Pine. No. 22. Dr. A. Minks, The Lichen Question.

Botanische Zeitung, No. 30. De Borbás, Concerning some Iridaceæ, especially those of Hungary. Warnstorf, Two New European Musci. Reports of Societies. No. 31. Dr. Harz, On the Origin and Properties of Spergulin (a new fluorescent from the seed-coats of *Spergula vulgaris*).

ZOÖLOGY.[1]

Development of Unfertilized Eggs of Vertebrates and Mollusca. — In the August number of the Naturalist I notice a letter from Mr. E. Lewis Sturtevant on the development of unfertilized eggs in the body of the female pickerel, and as the subject is one of great interest, I subjoin a few extracts from my notes, which relate to similar observations.

Dr. Burnett says (Proc. Amer. Acad. of Arts and Sciences, iii., 1847, page 44), "In the ova of the common cod-fish (*Gadus morrhua*) before they are expelled from the ovaries, and therefore before impregnation, I have seen phenomena indicating that the segmentation of the vitellus had already commenced." Professor Agassiz says (Proc. Boston Soc. Nat. Hist., vi., 1856, page 9) that eggs in various early stages of development may be found in the ovaries of the cod, whiting, and hake; but he opposes Burnett's view that this is to be regarded as proof of partheno-genesis, and holds that it rather proves copulation and internal impregnation. According to Bischoff (Mém. sur la Maturation et la Chute periodique de l'Œuf de l'Homme et des Mammifères, indépendant de la Fécondation, Ann. d. Sc. Nat., iii., ser. zool. ii., page 135, 1844) a few of the eggs laid by a female frog which had been kept in solitary confinement are found to go through the early stages of development.

In the *Monthly Microscopical Journal* for July, 1876 (page 44), there is a notice of similar observations upon the frog, which were communicated to the Académie des Sciences. According to this observer the first stages of segmentation were found in some of the eggs dropped by a female frog which had been kept in confinement for about four months, and secluded from all possible intercourse with the male. Segmentation was more rapid and irregular than in fertilized eggs at the same temperature. Only a small number of eggs commenced development; the majority died at once, and the rest very soon and before the mulberry stage was reached. The same phenomenon has also been seen by Leuchart.

Oebacher finds that the eggs laid by virgin hens, which have been reared in confinement, undergo segmentation and form a blastoderm

[1] The departments of Ornithology and Mammalogy are conducted by Dr. Elliott Coues, U. S. A.

while in the oviduct. In the case of the hen this does not seem to be exceptional but normal, as it appears to occur in nearly every case; and Oebacher concludes from his observations upon the subject (Die Veränderungen des unbefruchteten Keimes des Hühnereier im eileiter und bei Bebrütungsversuchen, Zeitschr. f. Wiss. zool., xxii., 1872, page 220): "We may therefore state confidently that the hen's egg goes through the process of segmentation during the intrametral period, whether it is fecundated or not, and we must therefore regard it as brought about by the organization of the egg itself, and not as caused by the influence of the male fluid."

Bischoff has found eggs in various stages of segmentation in the ovaries of a virgin sow which had been carefully separated from the male during life, and Hensen has made similar observations upon the rabbit. According to Vogt (Bilder aus dem Thierleben, page 217) the unfertilized eggs of *Firola* undergo segmentation; and Quatrefages records the same thing in *Unio* (*Compt. Rend.*, 1849, page 101). In the *Niades* the eggs are certainly discharged from the ovaries before impregnation takes place, although it is of course possible that some of the spermatic fluid may gain access to the oviduct. As the cilia of this duct are so placed as to cause an outward current this is hardly probable, and I have found and figured segmented eggs in the follicles of the ovary of *Anodonta*. These eggs were taken from the ovary a few days after the brood for that year had passed into the gills; and they were fully grown and ripe, and were very plainly the remnants of the brood of that season, which from some cause had failed to escape into the oviduct and pass into the gills. They did not differ in any particular from fertilized eggs at the same stage of development.

These cases are by no means all which might be collected to show that in groups of animals in which partheno-genesis does not occur, the eggs have still the power to go through part of the process of development without fertilization, and I believe, from conversations with fishermen and fish-breeders, that among fishes this is by no means rare. As partheno-genesis is normal among many of the lower animals, and since traces of the same power are thus found among the higher vertebrates, I think that we must conclude that the egg has in itself the power to form a new individual, although this power is never perfectly, and usually not at all, shown until development is excited by the influence of the spermatic filaments of the male. — W. K. Brooks.

A Black Rattlesnake. — While exploring the cañon of Alameda Creek, about one mile and a half beyond Niles Station, California, one of the civil engineers of the Central Pacific Railroad Company, on the 30th of July, came across a rattlesnake as black as jet, without even a white shade on the belly. The snake had ten rattles, and was three feet in length. Rattlesnakes are not uncommon in this part of the State, and are sometimes killed in Strawberry Cañon, near the university at Berkeley. — R. E. C. S.

Northern Range of the Bison. — Mr. E. W. Nelson, the well-known ornithologist, now in charge of one of the government meteorological stations in Alaska, writes me as follows under date of St. Michael's, Alaska, July 11, 1877: "I have met here two gentlemen who crossed the mountains from British Columbia and came to Fort Yukon through British America, from whom I have derived some information about the buffalo (*Bison Americanus*) which will be of interest to you. These gentlemen descended the Peace River, and on about the one hundred and eighteenth degree of longitude made a portage to Hay River, directly north. On this portage they saw thousands of buffalo skulls, and old trails, in some instances two or three feet deep, leading east and west. They wintered on Hay River, near its entrance into Great Slave Lake, and here found the buffalo still common, occupying a restricted territory along the southern border of the lake. This was in 1871. They made inquiry concerning the large number of skulls seen by them on the portage, and learned that about fifty years before snow fell to the estimated depth of fourteen feet, and so enveloped the animals that they perished by thousands. It is asserted that these buffaloes are larger than those of the plains." This is confirmatory of the statements I have elsewhere given of the comparatively recent presence of the bison near Great Slave Lake and on Peace and Hay rivers. — J. A. Allen.

ANTHROPOLOGY.

Anthropological News. — Two very important contributions to American ethnology have just been issued from Major Powell's office. One is entitled Introduction to the Study of Indian Languages, with Words, Phrases, and Sentences to be collected, by J. W. Powell. The paper is to be one of the chapters of a Manual of North American Ethnography, which Major Powell will shortly publish with the aid of eminent specialists. The other work is volume i. of Contributions to North American Ethnology, issued by the Interior Department. Part I. of this volume contains On the Distribution and Nomenclature of the Native Tribes of Alaska and the Adjacent Territory, by W. H. Dall. On a Succession of Shell-Heaps on the Aleutian Islands, by the same. Remarks on the Origin of the Innuit, by the same. Appendix to Part I. contains Notes on the Natives of Alaska, by J. Furnhelm. Terms of Relationship used by the Innuit, by W. H. Dall. Comparative Vocabularies, by George Gibbs and W. H. Dall. Part II. embraces a paper on the Tribes of Western Washington Territory and Northwestern Oregon, with Maps, by G. Gibbs. The appendix to Part II. contains Comparative Vocabularies, by Messrs. Gibbs, Tolmie, and Mengarini; Niskwalli-English Dictionary and English-Niskwalli Dictionary, by G. Gibbs.

The Davenport Academy of Natural Sciences has issued Part I. of

volume ii. of their proceedings, a handsome brochure of 148 pages. The academy, which has grown to be one of the most efficient local societies in the country, contemplates erecting a building for its meetings and for the exhibition of its specimens. The following is a list of the papers on archæology: Exploration of a Mound near Utah Lake, by Julia J. Wirt; Manufacture of Pottery by Mojave Indian Women, by Dr. E. Palmer; Shell Money and other Primitive Currencies, by W. H. Pratt; Mound Explorations in Jackson County, Iowa, by C. T. Lindley; Exploration of Mound No. 3, Cook's Farm Group, and Discovery of Inscribed Tablets, by Rev. J. Gass; On the Inscribed Tablets found by Rev. J. Gass, by R. J. Farquharson; Recent Find of Skulls and Skeletons in Ohio, by Rev. S. D. Peet; Exploration of Mound No. 10, Cook's Farm Group, by Rev. J. Gass; Description of Inscribed Stones found in Cleona Township, Scott County, Iowa, by Rev. J. Gass; Exploration of Mounds on the Farm of Col. William Allen, by W. H. Pratt.

From the author, C. C. Abbott, M. D., we have received a pamphlet reprinted from the Tenth Annual Report of the Peabody Museum, entitled Discovery of Supposed Palæolithic Implements from the Glacial Drift in the Valley of the Delaware River, near Trenton, N. J. As the result of his investigations the author comes to the conclusion that "the rude implements found in the gravel were fashioned by man during the glacial period, and were deposited with the associated gravels as we now find them."

Mr. W. H. Jackson, of the Hayden Survey, has added another trophy to those that decorate his cliff dwelling in the fourth story of the Second National Bank Building, Washington. Having gone out to New Mexico in the spring he made accurate measurements of one of the best preserved of the pueblos, and has now reproduced it in plaster in exact proportions. These plaster models by Mr. Jackson are certainly the best object-lessons in American archæology we have ever seen.

The State Archæological Association of Indiana held its meeting September 12th and 13th, at Indianapolis. The American Anthropological Association met at Cincinnati, September 5th, and the Anthropological Subsection of the American Association at Nashville, Tenn., August 29th.

Nature for May 24th and the following five or six numbers contain a valuable report of a conference held by the London Anthropological Institute, concerning our present knowledge of the antiquity of man in England. Messrs. John Evans, Dawkins, Hughes, Teddemann, Busk, Rolleston, Fox, Sayce, Callard, and Harrison took part in the discussion. The result of the conference seems to have been that as yet no positive evidence has been adduced of the preglacial or intraglacial existence of man in England. Messrs. Belt, Geikie, and Sketchly, in subsequent communications to *Nature*, take issue with this opinion.

In Part IV. of the last volume of the *Journal of the Anthropological Institute* the following subjects of general interest are discussed: The Measurement of the Officers and Men of the Second Royal Survey Militia, by Col. Lane Fox; The Chalk at Cissbury, by J. Park Harrison; The Ethnology of the Germans, by H. H. Howorth; On the Classification of Arrowheads, by W. J. Knowles; On Language and Thought, by Henry Sweet.

Prof. Wills de Hass has issued a Syllabus of a Course of Lectures on American Prehistoric Archæology before the College of Fine Arts, Syracuse University. This being the first attempt to popularize in this manner the whole subject of prehistoric archæology in our country, we would congratulate his hearers if the richness of the lectures bear any comparison with the luscious bill of fare.

We would call the attention of our readers to two works of extraordinary merit, from the pen of our countrymen, and regret that want of space forbids an extended review of them. The one is Peru; Incidents of Travel and Exploration in the Lands of the Incas, by E. George Squier; and the other, Ancient Society: or, Researches in the Lines of Human Progress from Savagery, through Barbarism, to Civilization, by Lewis H. Morgan. Both are the mature if not the final work of our most distinguished anthropologists, — authors whose works are known and whose praises are spoken wherever men are found who look with tenderness upon those mementoes of antiquity which in their day were the stepping-stones of history.

Many archæologists have been astonished at the beauty of form and the exquisite finish of the jadeite celts found in the West Indies, and have often wondered how they were hafted and put to use. The problem has been solved recently by two celts sent to the National Museum from Turk's and Caicos islands, by Mr. George Gibbs. One of them is a light jadeite, oval-sectioned celt set in a mortised handle of hard wood; in the other, the handle and blade are of a single piece of jadeite, sculptured to imitate a celt in a wooden handle. They will be figured in the forthcoming Annual Report of the Smithsonian Institution. From the same locality two low wooden stools were sent by Professor Gabb and Mr. Frith, answering exactly to those described by Herrera and the other historians of the voyage of Columbus. They are made of a single piece of wood, in imitation of a turtle, the head and fore legs projecting in front, and the tail rising to form the back of the stool. These, too, are valuable in establishing the use of certain sagged stone implements hitherto called metates. One of these stone seats in the National Museum, belonging to the Latimer collection, is a fac-simile of the wooden stools above described. These will also be figured in the Smithsonian report for the present year.

A very valuable contribution to American ethnology is Ethnography and Philology of the Hidatsa Indians, by Washington Matthews, assist-

ant surgeon U. S. A., published as No. 7 of Professor Hayden's Miscellaneous Publications. The work forms an octavo volume of 240 pages, and contains, in addition to the grammar and dictionary proper, a very valuable monograph of the Hidatsa, and of their neighbors at Fort Berthold, the Aricarees and Mandans.

Dr. Dalrymple, of Baltimore, has made an exhaustive study of the Pamunkey and Mattapony Indians of Eastern Virginia. They are a miserable half-breed remnant of the once powerful Virginia tribes. The most interesting feature of their present condition is their preservation of their ancient modes of making pottery. It will be news to some that the shells are calcined before mixing with the clay, and that at least one third of the compound is triturated shells.

The discussion of the subject of reform spelling still continues in *The Academy* of June 2d, 9th, and 16th. The chief value of this discussion to the American ethnologist is the aid which a perfect phonetic alphabet would render to those who are engaged in collecting vocabularies or in perfecting the synonymy of the tribes. — Otis T. Mason.

GEOLOGY AND PALÆONTOLOGY.

On the Existence of the Alleghany Division of the Appalachian Range within the Hudson Valley. — In preparing for the last summer campaign of the Harvard Summer School of Geology, my assistant, Mr. William M. Davis, Jr., made a preliminary study of the district lying between the Hudson River and the foot of the Catskill Mountains. From his observations it became evident to both of us that there were peculiar disturbances affecting this district which had remained unnoticed by the officers of the New York surveys. Last month I visited this region along with the Summer School of Geology. A few days' study made it plain to me that Mr. Davis's observations had given us a clew to an important fact in American geology, and that these dislocations, consisting of several abruptly folded anticlinals and synclinals originally having several hundred feet relief, are in fact the northward extension of the disturbances that made the Alleghany division of the Appalachian chain; while the Catskill Mountains similarly are the northward extension of the slightly disturbed table-land known as the Cumberland table-land in the valley of that stream, and by various names in the more northern localities. It will not be possible to give full details of this interesting series of disturbances until the sections and maps made by the summer school are fully worked up, which cannot be for some months to come. It may be said, however, that this structure has been traced about thirty miles along the Hudson River, and that the several anticlinals closely resemble those of Pennsylvania in all their general features: they are, however, smaller, more closely packed together, with much steeper dips, often running up to 50° of declivity, and are somewhat more faulted, but in the direction of their steeper dips their rela-

tions to each other, as well as in all the topographical effects they exercise on the surface, they exactly reproduce the Pennsylvania mountains. I now have no question that the Alleghany disturbances are crowded into the valley of the Hudson, where, worn down by glacial, fluviatile, and at times perhaps marine agencies, and masked by glacial drift, they have hitherto escaped the attention of geologists, and that we must abandon the idea that the disturbances of that age run out beneath the Catskill table-lands.

That it may be seen that these anticlinals are no petty accidents, I may say that the largest yet traced is not less than twenty miles long, a mile or more in width, and if restored would be nearly two thousand feet high. The beds involved in the disturbance include the greater part of the New York Palæozoic section. — N. S. Shaler.

On the Occurrence of the Genus Beatricea in Kentucky. — The genus *Beatricea* described by Billings as a group of fossil corals, and at one time regarded by Hyatt as belonging to the Cephalopods,[1] has hitherto been found only upon the island of Anticosti, in the Gulf of St. Lawrence. The investigations of the Kentucky Geological Survey have now traced this genus into the limits of that commonwealth. There, as in Anticosti, it is the companion of reef-building forms of corals growing in the shelter of very large masses of *Columnaria* and *Tetradium*, and occupying the horizon of the uppermost part of the Cincinnati group. In the new locality the genus is represented by two distinct forms, comparable with the *B. nodulosa* and *B. undulata* of Billings, though perhaps not strictly identical with them. Specimens of these Kentucky forms were exhibited at Nashville. Professor Whitfield, there called attention to the fact that the microscopic structure of this puzzling fossil closely resembled that found in the *Stromatopora* group. On further examination of these forms I am inclined to accept the conclusions to which we are led by this acute observation of Professor Whitfield and to regard these fossils as probably belonging to the group of sponges. Those who are familiar with the Palæozic sponges will recognize certain approaches to the general form of *Beatricea* among the unquestionable sponges of that time. Certainly the affinities as far as traced are much more reconcilable with those of the group of sponges than with those of the corals. I think this is a more profitable field of inquiry than any other that has suggested itself to me concerning these curious remains. For some years I have been doubting whether they had not some genetic relations with the *Hippurite* group of the *Rudistes*. I should not mention this conjecture, though there is a good deal that appears to support it, were it not that Prof. James Hall tells me he has been inclined to take the same view of their relations. There can be no doubt, however, that the field opened by Professor Whitfield's observations is much more promising. — N. S. Shaler.

[1] I am authorized by Professor Hyatt to say that he is now satisfied that they cannot be regarded as Cephalopods.

The Largest Known Saurian. — Professor Cope recently described a new genus and species of saurian with ambulatory limbs under the name of *Camæosaurus supremus*, which exceeds in dimensions any known land animal. The skeleton was found by Mr. O. W. Lucas near Canyon City, Colorado, and a great part of it was preserved in good condition through the labors of that gentleman. Its dorsal vertebræ are occupied by large chambers, a structure in which it differs from *Cetiosaurus*, a genus which it otherwise resembles. Its neck vertebræ are of remarkable form, and the neural arches of the dorsal vertebræ greatly elevated. One of the dorsal vertebræ has an expanse of three and one half feet; another is two and a half feet in elevation. The femur measures over six feet in length, and the tail was very long. If the cervical series included six vertebræ of the proportions of the one preserved the neck was ten feet in length. Another species allied to this one was recently sent to the Yale College museum from a point about one hundred miles north of Canyon City, but it appears to be a smaller animal, and the bones are in an inferior state of preservation.

Remains of a Huge Saurian in Pennsylvania. — At the recent meeting of the American Philosophical Society, Professor Cope called the attention of the members to a number of teeth of a huge land saurian which evidently inhabited Pennsylvania at an early geological period. The specimens were found by Charles M. Wheatley, of Phœnixville, Pa., in one of the copper mines, in the red sandstone and shale which traverses the State from northeast to southwest, in the eastern section. This reptile, which is new to science, was probably thirty feet in length, with a bulky body, supported by heavy limbs. The teeth are double-edged and finely serrate, and of the kind characteristic of the carnivorous saurians. The reptile was doubtless one of the most formidable that ever inhabited the State, and in point of time the earliest. It has received the name of *Palæoctonus Appalachianus*.

New Vertebrate Fossils. — Prof. O. C. Marsh, in the *American Journal of Science* for September, describes several new species of mammals, birds, reptiles, and fishes from different localities in the West. "Among the mammals are two Miocene Edentates, the first detected in this country, and a third species of this group from the Lower Pliocene. Another mammal of much interest is a rhinoceros from the Eocene, the oldest known member of the family. A number of new genera are introduced, some of which have an important bearing on the genealogy of Tertiary mammals. Among the other vertebrates is a new genus of Crocodilians from the horizon of the Wealden, and a new species of *Crocodilus* from the Pliocene." A new tapiroid animal, intermediate in structure between the extinct *Lophiodon* and the existing tapir, is described from remains from the Miocene of New Jersey (formerly referred to *Lophiodon*) and the Lower Pliocene east of the Rocky Mountains. Two species of *Bison* (*B. ferox* and *B. Alleni*) from the Lower Pliocene

of Kansas and Nebraska are based on fragments of horn cores. These indicate animals much larger than the existing species, but smaller than the large extinct *Bison latifrons*. Another interesting type of mammal combines some of the features of the ungulates with others of the rodents, to which latter it is evidently related. The species (*Allomys nitens*) is founded on remains from the Upper Miocene of Oregon, and is regarded as representing a distinct family, *Allomyidæ*. A new bird of the size of a small duck is characterized from remains from the Cretaceous of Texas.

GEOGRAPHY AND EXPLORATION.

Exploration in Patagonia. — Don F. P. Moreno has recently made an exploration from Santa Cruz Bay, by way of the Santa Cruz River, northward across the high interior of Patagonia, the so-called "Plains of Mystery" of Admiral Fitz Roy, to the base of the Cordilleras. He explored the lake, which had never before been sailed upon, forming the source of the Santa Cruz, and crossed the tertiary tablelands to the northward. These plains have an altitude of two thousand five hundred to three thousand feet, with summits capped with basalt. To the westward and northward he met with a chain of small lakes inclosed by excellent pasture, and later reached an unknown lake of considerable dimensions, named by him Lago San Martin. The lake is surrounded with snow-capped mountains, which are wooded on the sides and rise to a height of three thousand to five thousand feet. He also visited the so-called Viedma Lake, and made collections of fossils from the plains. On a portion of the shores of the lake from which the Santa Cruz takes its rise was discovered an ancient habitation of some of the primitive people of Patagonia. A detailed report of his expedition is promised.

Heights in the Bolivian Andes. — According to the *Geographical Magazine*, Mr. Minchin, the civil engineer who has been doing such useful geographical work in Bolivia, has determined, from the results of his leveling for the railways between La Paz and Lake Titicaca, the height of the peak of Illimani to be 22,224 feet, which he thinks cannot vary more than ten feet from its true height. It is hence about 175 feet lower than the elevation given by the most trustworthy measurements for the peak of Aconcagua in Chili, believed to be the highest point of the Andes. Mr. Minchin gives the height of Lake Titicaca as 12,545 feet, or 245 feet less than Pentland's height, based on barometric measurement. The height of Alto de la Paz is given as 13,389 feet, and that of Plaza Mayor, La Paz, as 11,946 feet.

Geographical News. — Mr. F. A. Edwards has published, in the *Gentleman's Magazine* for August, a paper on Colonel Gordon's Expedition to the Upper Nile Region, illustrated by a sketch map. The *Geographical Magazine* for August contains a sketch map of the coun-

try round Lake N'yassa. In the same number is an extended notice, by Keith Johnston, of the cartographical publications of the Indian Survey. These include, besides numerous maps of special districts, the "long-expected" General Map of India. A book relating to the discoveries of the fifteenth century has been published by Richard Henry Major, entitled The Discoveries of Prince Henry the Navigator, and their Results; being the Narrative of the Discovery by Sea, within One Century, of More than Half the World. This period includes the exploration of the coasts of Africa, the discovery of America and Australia, the circumnavigation of the globe, and the opening of a sea-way to India, the Moluccas, and China. J. W. Boddam Whetham, in a book entitled Across Central America, gives interesting notes of travel through a hitherto rarely visited region, with an account of some of the wonderful ruins of Central America.

MICROSCOPY.[1]

E. Gundlach's New Periscopic Eye-Piece. — The Hughenian eye-piece, as originally constructed, consists, as is well known, of two plano-convex lenses, of which one, the field-lens, has three times the focal length of the other, the eye-lens, the distance between the two being equal to double the focal length of the eye-lens, the plane side of the field-lens facing the convex side of the eye-lens.

The field-lens not only widens the field of view but also corrects the spherical as well as the chromatic aberration, as it is placed beyond the focal distance of the eye-lens (which is the actual eye-piece), and in consequence thereof acts negatively to the same.

This correction, however, is not a complete one, for with the most favorable distance between the two lenses a not inconsiderable remnant of the chromatic aberration still remains, while the spherical aberration is already correspondingly over-corrected. The first is noticeable by the blue edge bordering that side of the object which is turned toward the centre, when the object is placed towards the edge of the field; the remnant of the spherical aberration causes the distortion and want of sharpness of definition at the edge of the field. By increasing the distance between the field-lens and eye-lens the blue color may indeed be made to disappear, but the spherical aberration increases correspondingly, and the field is narrowed considerably. If, on the contrary, the field-lens is brought closer to the eye-lens, the spherical aberration is certainly diminished; but notwithstanding this, the image at the edge of the field does not become any more sharply defined, because the chromatic aberration has increased in equal ratio.

One advantage, however, is gained by approaching the field-lens closer to the eye-lens, namely, a considerable widening of the field.

If, under these circumstances, the aberrations of the eye-lens are cor-

[1] Conducted by Dr. R. H. Ward, Troy, N. Y.

rected by suitably composing the same of flint and crown glass, we have an eye-piece which, with all the advantages of the Hughenian eye-piece, surpasses the latter by having a larger field.

These facts form the basis of the construction of the Kellner orthoscopic eye-pieces. Kellner brought the field-lens into the focus of the eye-lens, made the latter achromatic, and chose such curvatures as to remove the spherical aberration and show a flat field, for which latter purpose he also transformed the plano-convex field-lens into a double-convex one.

The simultaneous accomplishment of all these results was favored by the circumstance that in approaching in a Hughenian eye-piece the field-lens to the eye-lens the spherical aberration diminishes more rapidly than the chromatic. The preponderance of the latter over the former in the Hughenian eye-piece must therefore admit of being equalized at a certain point, or rather must accommodate itself at this point to a similar disproportion in the achromatic eye-lens. This point, however, is, as in the Kellner eye-piece, almost exactly the focus of the eye-lens.

A further approach of the field-lens to the eye-lens (bringing the latter within the focus of the former), again gives the preponderance to the chromatic aberration, and an equalization by an achromatic double lens becomes impossible under the circumstances.

If, however, such further approach should be possible without such or other disadvantages, it would be very desirable, not only on account of the enlargement of the field which it would cause, but also on account of the circumstance that when the field-lens is in the exact focus of the eye-lens every fine particle of dust on the former is clearly visible and sharply defined, greatly interfering with the observation.

These facts and considerations caused me to reflect whether a triple eye-lens (consisting of two positive crown-glass lenses and one negative flint-glass) instead of a double lens would not better answer the conditions, and I have in consequence succeeded in forming such a lens which answers the purpose in a very high degree.

My new "periscopic eye-piece" consists of a triple eye-lens, a double-convex field-lens, the latter being situated within the focal distance of the former, and a diaphragm located in the focus of the equivalents of both lenses.

The field of the new eye-piece is considerably larger and flatter than that of Kellner's, and the image is sharply defined to the extreme edge.

As the focus of this eye-piece lies behind the field-lens (the same as in Ramsden's eye-piece), it is particularly suitable for micrometers, especially as the division is distinctly and in correct proportion visible to the extreme edge, which is notably not the case with Ramsden's eye-piece.

A micrometer division placed in the focus of this eye-piece shows, moreover, very perspicuously the high degree of the correction of the aberrations, while the image transmitted by an objective can be no relia-

ble test, as the aberrations of the objective, particularly the distortion, are easily confounded with those of the eye-piece. — E. GUNDLACH.

OBJECTIVES AS ILLUMINATORS. — Mr. George W. Morehouse urges strongly the use of the best attainable objectives as substitutes for the various illuminating accessories furnished with microscopes, on the principle that the illuminator should exactly equal the magnifier in capacity in all respects, which he has not found true of any of the illuminators. By using immersion objectives of the highest angle, properly centred and focused, as achromatic condensers, he believes the truest appearance of the object is obtained, and with the least liability to errors of interpretation, the images of structure lying in different focal planes being separated with the greatest accuracy. Of course, the objects for this use must be mounted in balsam between two thin cover-glasses, or if mounted dry they must be in actual contact with both glasses.

He has also had more than ordinary success with the plan of making the objective its own illuminator for opaque objects, first successfully introduced by Prof. H. L. Smith. He uses the form known as Beck's vertical illuminator, which is a thin glass disk in an adapter above the objective, light from a flat-wicked lamp placed edgeways, at a distance of about eight inches, being reflected by the disk through the objective upon the object. The image of the flame should be seen in the centre of the field, where, with immersion objectives of the highest angle, details of surface structure can be seen with the greatest distinctness with powers as high as four thousand diameters. The projecting spines upon the test podura scales can be thus seen both on the surface and at the edge of the scales; and even objects that only imperfectly reflect the light, such as diatoms, can be distinguished with clearness and beauty. *Pleurosigma angulatum* is seen in hexagons, and *A. pellucida* shows the striæ sharply when the illumination is rendered one-sided by the hand or any other obstruction held partly between the flame and the reflecting disk.

MOUNTING IN DAMMAR. — The occasional failure of specimens mounted in dammar to keep well, by reason of the external ring of varnish running in, or other disaster due to imperfect hardening of the dammar, has led to an interesting and useful discussion in the pages of *Science Gossip*. The best method seems to be to place the object, previously soaked in turpentine or benzole, on the slide, and then either drop the dammar on the object and press down on it the slightly warmed cover-glass, or else place the object from the turpentine on the slide, cover it with the cover-glass, and allow the dammar to flow in assisted by a moderate warmth, — in either case the slide being at once transferred to a metal plate about six inches above the flame of a spirit lamp. As the heat should not be sufficient to boil the dammar, air bubbles will not form, and the progress of the drying need not be closely watched while attending to other work. In about an hour the dammar will be so hardened as to be quite safe, the precise time to remove it from the plate being determined by taking up

on the point of a pin a particle of the superfluous material which has collected at the edge of the cover, which should form, when cold, a globule perfectly hard and not at all sticky.

Opaque-Glass Slides. — Mr. Carl Meinerth contributes to the Postal Club a slide having an opaque object mounted on a slide of white porcelain-glass. Some years ago Rev. E. C. Bolles suggested a similar use of black glass for white objects. Both methods make very handsome slides, though for real usefulness we prefer the ordinary slides, as there is scarcely an object on which it might not at some time be desired to pass light through the glass, while a dark background can always be easily secured.

Exchanges. — Diatomaceous material containing triceratium wanted in exchange for mounted specimens. Address G. C. Morris, E. Tulpehocken St., Germantown, Philadelphia.

"Plumule" scales of small cabbage butterfly (*Pieris Rapæ*), mounted, for good slides. Address Edward Pennock, 805 Franklin St., Philadelphia.

SCIENTIFIC NEWS.

— As the close season for salmon commences August 1st and extends to November 1st, no more of these fishes will be on sale while they are spawning in our rivers. The law is very stringent against their sale during the season, and makes it a misdemeanor to catch, sell, or have them in possession. — *San Francisco paper.*

— Dispatches of July 2d state that plentiful rains have fallen lately in the famine-stricken districts of Northern China, and the crops are in a flourishing condition. Locusts have, however, appeared in some parts and committed great ravages.

—The Shepard Scientific Collections have recently been purchased by the authorities of Amherst College, at a cost of $40,000, a sum about one half their appraised value. These collections are three in number, a geological, a mineralogical, and a meteoric. The mineralogical collection is one of rare beauty and value, while the meteoric ranks as the fourth in point of size and interest in the world. The college has thus secured some of the most important and valuable collections possessed by any university, either in this country or in Europe. These collections were taken to Amherst from New Haven in 1847, and although deposited by Professor Shepard in the college cabinets at Amherst have hitherto been the property of Professor Shepard.

—Dr. A. B. Meyer, director of the Royal Zoölogical Museum of Dresden, announces his intention to publish figures of rare bird-skeletons, hitherto not at all or insufficiently figured. The work will be issued in parts, containing ten plates each, at intervals of about three months. The price of each part will be fifteen shillings, and the edition limited.

—Messrs. A. O. Hume, C. H. T. and G. F. L. Marshall will shortly

begin the publication of a work on the Game Birds of India, with colored illustrations of all the known species. The work is to be issued in three volumes, and will comprise not only the grouse, bustards, pheasants, jungle fowls, partridges, etc., but also the rails, cranes, swans, geese, ducks, snipes, woodcock, godwits, etc. Price per volume, twenty-one shillings six pence.

—Professor E. S. Morse, of Salem, Mass., is now busy with dredge and microscope in Japan, having fixed his headquarters at Inoshima, seventeen miles south of Yokohama. Recently he ascended one of the highest of the Japanese mountains, about one hundred miles from the coast, and found opportunity there for dredging Lake Chiusenji, a body of water 4000 feet above sea level. Its fauna was ascertained to be quite peculiar. Professor Morse will return to the United States in time for his usual courses of lectures during the coming autumn and winter; but afterwards, in 1878, he expects to go back to Japan, having accepted an engagement in the Imperial University of Tokio, as professor of biology. He has also projected a summer school of natural history, to be conducted on the coast near the university. His text-book for beginners in zoölogy is to be translated into the language of Japan, and animals native to that country are to be substituted for the American ones referred to throughout the volume.

—During the eruption of Cotopaxi, on the 26th of last June, the volcano, according to a writer in the *Nation* of September 6th, poured out a cataract "ten times the bulk of Niagara," which swept away everything before it in its course and submerged a large extent of the surrounding country. The torrent divided and descended in several directions, one branch flowing southerly toward the city of Latacunga, twelve miles distant, but before reaching the city met the beds of three rivers, which carried away the waters and saved it from threatened destruction. The torrent, however, submerged the plain of Callo, and destroyed crops, factories, cattle, and bridges, and it is thought the ruins of the palace of the Incas, described by Humboldt, have not escaped its ravages. Another branch devastated the fertile valley of Chillo, destroying property valued at over two millions of dollars, while the loss of property in other sections is said to be equally great. It is also estimated that the loss of life will exceed one thousand souls. Although the surroundings of Quito were laid waste, the city itself suffered only from a storm of ashes, which fell first in the form of coarse, heavy sand, and later as a fine, impalpable dust, which penetrated everywhere. The darkness was intense for many hours and a reign of terror pervaded the city. It is said that ten years of peace and prosperity, of which there is now in Ecuador faint prospect, will not suffice to repair the evils wrought in a few hours during this memorable eruption.

— News to July 12th received by recent mails fully establishes the connection between the tidal phenomena observed on the northern coast of

Japan on the 11th of May and the disturbances which wrought, almost simultaneously, such destruction on the Peruvian coast, and were unquestionably the cause of the tidal waves, whose effects were noticed in such equally remote places as Hawaii and the eastern shores of the Australian continent.

— In the San Joaquin and other valleys to the southwestward the plains are so parched that the whole surface of the earth presents the appearance of an ash bank. Even the ground-squirrels are deserting the plains and moving up toward the foot-hills in search of food. The Indians regard this migration as indicative of an approaching wet winter. — R. E. C. S.

— Specimens of silver ore recently taken from the Cerro de Pasco silver mines in Peru show that the submerged portion of the mountain is very rich, and a rough estimate indicates that a body of ore will be exposed by the new tunnel which Meiggs, the South American railroad king, is to build, worth from three hundred million to five hundred million dollars. These mines have laid under water for fifty years, and are scarcely known to the present generation, though they had been worked for two hundred and fifty years, when the miners had to stop on account of the water. Peru has now discovered that a tunnel can be built which will drain the mountain completely by drawing off the lake from which the water in the mine comes; the first loads of the now submerged ore are expected to reach Lima in four months. It is predicted that within ten years more silver will be taken out than from the silver mines in Nevada. This tunnel will in importance be a rival to the famous Sutro tunnel, which is to drain the great Comstock lode of Nevada, though the latter is of much greater extent. — R. E. C. S.

PROCEEDINGS OF SOCIETIES.

The American Association for the Advancement of Science. — The twenty-sixth meeting of the association was held at Nashville, Tenn., beginning August 29th and ending September 4th, — the first gathering of the association in a Southern city for nineteen years. One hundred and seventy members and fellows were in attendance, and about two hundred and twenty new members were elected; thirty were added to the list of fellows. Although the number of fellows and members present was less than at some former meetings, the number of new members added was considerably above the average, and the papers read will compare favorably in point of number and quality with those of previous sessions. The reception tendered by the citizens of Nashville to the association could scarcely have been more cordial or appreciative, while the greatest harmony and good feeling characterized the deliberations of the meetings. The reason for the rather smaller attendance than usual is not far to seek, being evidently due in part to the great

distance of the place of meeting from the homes of most of the members, and to the fact that at this season of great heat the tendency is toward migration in the direction of the pole rather than the equator. The almost unbounded hospitality tendered the association by the authorities and citizens of Nashville and neighboring cities will make the session one long to be remembered by the members whose good fortune it was to be present, while the meeting must tend to stimulate scientific pursuits in the South and cement more closely the lovers of science and learning of all sections. As the president happily remarked in his response to the address of welcome by Judge J. M. Lea (in behalf of the governor of Tennessee, who was necessarily absent), nothing of a political nature estranges from each other the lovers of science, and consequently at this first meeting of the association in a Southern city since internal dissensions so sorely rent our country no reconciliations were necessary. At the close of the meeting of the association the members, by invitation, made an excursion to Chattanooga and Lookout Mountain, a portion of them extending the trip to Central Alabama, reaching Nashville on their return on Saturday, September 8th.

In the absence of the retiring president, Prof. William B. Rogers, the meeting was called to order by Prof. James Hall, who introduced the president-elect, Prof. Simon Newcomb. Owing to illness Professor Rogers had been unable to prepare the customary address expected from the retiring president. The address of the vice-president of Section B (geology and natural history), Prof. O. C. Marsh, on the Introduction and Succession of Vertebrate Life in America, was, from the nature of the subject and the high authority of the author on all matters relating to this important question, *the* event of the natural history section. Passing rapidly over the lower groups, Professor Marsh spoke more particularly of the higher vertebrates, these being the most important witnesses of the past, since through their higher organization they were more susceptible to the influences of slight climatic changes which would otherwise have remained unrecorded. They further possess interest inasmuch as they more closely approach man in their structure, and thus throw light upon his probable origin.

The address of the vice-president of Section A, Prof. E. C. Pickering, who was unable to be present, was read by the temporary chairman, Professor Thurston, the subject being The Endowment of Research. With the man of science there is generally little or no pecuniary reward for his success. Consequently he is obliged to engage in some other occupation, generally teaching, which still allows a little time for research. If these same men were able to devote their entire energies to investigation, and were aided by the necessary appliances, far more would be accomplished. The solution of the matter was organization, the carrying out of a plan by which researches should be rendered as systematic as the process of mechanical arts. A plan was proposed

for an institution for making researches; an ideal building suited to such a purpose was described, and a corps of trained investigators of acknowledged scientific ability, headed by a president and aided by a large body of assistants and workmen, was suggested.

The chairman of the subsection of anthropology, Dr. Daniel Wilson, being also unavoidably absent, his able address on Races in America was read by Permanent Secretary Putnam. The author in this address referred to the rich field America offers to archæologists, and called special attention to subjects of inquiry demanding the closest investigation.

Capt. W. H. Dall, who was appointed last year a committee on zoological nomenclature, presented an elaborate report on this subject. The report was highly commended and referred by vote to the standing committee, with a request for its publication.

Invitations were received to meet next year at St. Louis, Mo., and at St. Paul, Minn. The former place was chosen, where the meeting will open August 21, 1878. The following general officers were elected for the next meeting: president, Prof. O. C. Marsh, of New Haven; vice-president of Section A, Prof. R. H. Thurston, of Hoboken, N. J.; vice-president of Section B, A. R. Grote, of Buffalo, N. Y.; chairman of the sub-section of chemistry, Prof. F. W. Clarke, of Cincinnati, O.; chairman of the sub-section of microscopy, Dr. G. S. Blackie, of Nashville, Tenn.; permanent secretary, F. W. Putnam, of Cambridge; general secretary, Dr. H. Carrington Bolton, of Hartford, Conn.; secretary of Section A, F. E. Nipher, of St. Louis, Mo.; secretary of Section B, Dr. George Little, of Atlanta, Ga.; treasurer, William S. Vaux, of Philadelphia, Pa.

The following is a list of the papers read relating to geology, zoölogy, botany, anthropology, and microscopy: Aug. R. Grote, Our Knowledge of the Cotton Worm; A New Lepidopterous Insect Injurious to Vegetation; An International Scientific Survey; J. W. Powell, The Structure of Eruptive Mountains; William Bross, All Life conditionally Immortal; Thomas Meehan, On Sex in Flowers; Miss Virginia K. Bowers, The Law of Repetition; Burt G. Wilder, On the Respiration of Amia; Homer F. Basset, Agamous Reproduction among the Cynipidæ; N. S. Shaler, On the Original Connection of the Eastern and Western Coal-Fields of the Ohio Valley; On the Continuation of the Folds of the Alleghany Chain to the North of the Delaware River; A. C. Campbell, On the Mechanics of the Flight of Birds; Mrs. H. R. Ingram, Atmospheric Concussion as a Means of Disinfection; J. M. Safford, On the Silurian Island of the Cincinnati Uplift with Reference to its Past in Tennessee; N. S. Shaler, On the Geographical and Geological Distribution of the Genus Beatricea, and of Certain Other Fossil Corals in the Rocks of the Cincinnati Group; T. O. Summers, Jr., Some Observations on the Skull of the Comanche; E. D. Cope, On the Classification of the Extinct Fishes of the Lower Types; J. W. Powell, Overplacement;

N. S. Shaler, On the Recent Formation of a Small Anticlinal Axis in Lincoln County, Kentucky; E. D. Cope, On the Origin of Structural Variation; A. R. Grote and W. H. Pitt, New Specimens from the Water Lime Group at Buffalo; Samuel J. Wallace, On Geodes and Other Fossiloids; James E. Todd, On the Annual Deposits of the Missouri River during the Post-Pliocene; Ernst Gundlach, A New Periscopic Eye-Piece; Alexis A. Julien, Accessories adapted to Lithological Investigation; George W. Morehouse, Objectives as Illuminators; C. Leo Mees, On the Use of Ordinary Low-Power Objectives for Photography; R. H. Ward, On the Cellular Structure of Dentine; On a Modification of Wenham's Reflex Illuminator; T. O. Summers, Jr., On the Relative Values of the Powers of Objectives and Eye-Pieces; T. Sterry Hunt, Notes on the Silurian Waters of Washoe, Nevada; Shuze Isawa, On the Origin of the Japanese; Garrick Mallery, The Former and Present Numbers of our Indians; Henry Gillman, Additional Facts concerning Artificial Perforations of the Cranium in Ancient Mounds in Michigan; Edwin A. Barber, Habits of the Moqui Tribe; J. W. Powell, Some Popular Errors concerning the North American Indians; Alexis A. Julien, On the Ancient Excavations of Western North Carolina; H. N. Rust, Report on the Exploration of the Graves of the Mound Builders in Scott and Mississippi Counties, Missouri; J. W. Powell, Introduction to the Study of Indian Languages; Joseph B. Killebrew, Geology and Topography of the Oil Regions of Tennessee and the Oil Springs and Wells; T. Sterry Hunt, Notes on the Geology of the Rocky Mountains; James M. Safford, Notes of a Specimen of Cyrtodonta ventricosa from the Lower Silurian; A. E. Wetherby, The Variation of Certain Fresh-Water Mollusks of the United States, and their Geographical Distribution; J. H. Huntington, Geology of the Region on the Head Waters of the Androscoggin River; E. D. Cope, On the Characters of a New Cretaceous Saurian from the Rocky Mountains; E. L. Drake, A Section of McKinny Hill, Tennessee; B. S. Hedrick, On the Use to be made of Post Route Maps in the Advancement of Science: E. T. Cox, Geological Position and Mode of Origin of Hydrated Brown Oxide of Iron; R. L. Kirkpatrick, On the Relation of Organ to Function, or of Form in General to Mode of Energy received and exerted; James A. Ridley, On the Fibre of Gossypium herbaceum (cotton plant) considered with Reference to a Practical Application of its Manufacture.

SCIENTIFIC SERIALS.[1]

THE GEOLOGICAL MAGAZINE. — August. Across Europe and Asia. Traveling Notes (Part II.), St. Petersburg to Perm, by John Milne. A Sketch of the Geology of Keighley, Skipton, and Grassington, by J. R. Dakyns. Notes on the Correlation of the Beds

[1] The articles enumerated under this head will be for the most part selected.

constituting the Upper Greensand and Chloritic Marl, by A. J. Fukes Browne.

The Geographical Magazine. — August. The Arctic Expedition, xvii. Refutation of the Assertions of Hostile Critics. The Bengal Cyclone of 1876. Affairs in Japan, by R. H. Brunton. The Livingstonia Mission, by J. Thornton Macklin and J. Stewart. The Great Earthquake on the Coast of Peru of May 9, 1877. Exploration in Patagonia, by F. P. Moreno. The India-Rubber Trees in Brazil, by Robert Cross.

Science Gossip. — August. A Sketch of the Geology of Plymouth and the Neighborhood (illustrated). Botanical Notes in the Neighborhood of Cader-Idris. The Seals and Whales of the British Seas, No. 3 (illustrated). Another Sketch in the West of Ireland (illustrated). The Economical Products of Plants (illustrated). A Microscopical Slide-Box (illustrated).

Microscopical Journal. — August. A Simple Device for the Illumination of Balsam-Mounted Objects for Examination with Certain Immersion Objectives whose "Balsam Angle" is ninety degrees or upwards, by J. J. Woodward. An Essay on the Classification of the Diatomaceæ, by M. Paul Petit, translated by F. Kilton. Note on a New Paraboloid Illuminator for Use beneath the Microscope Stage. Also Note on the Resolution of Podura Scale by Means of the New Paraboloid, by James Edwards. The Development of the Ovum, by W. N. Dallinger and J. Drysdale. German Methods in Histology and Embryology, by Charles Sedgwick Minot.

American Journal of Science and Arts. — September. Notes on the Internal and External Structure of Palæozoic Crinoids, by C. Wachsmuth. Phenomena of Binocular Vision, by J. LeConte. The Relation of the Geology of Vermont to that of Berkshire, by J. D. Dana. Notice of a New Genus of Annelids from the Lower Silurian, by G. B. Grinnell. New Vertebrate Fossils, by O. C. Marsh.

Bulletin of the United States Geological and Geographical Survey of the Territories. — Vol. iii., No. 4. The First Discovered Traces of Fossil Insects in the American Tertiaries, by Samuel H. Scudder. Description of Two Species of Carabidæ found in the Interglacial Deposits of Scarboro Heights, near Toronto, Canada, by Samuel H. Scudder. Report upon the Insects collected by P. R. Uhler during the Explorations of 1875, including Monographs of the Families Cydnidæ and Saldæ, and the Hemiptera collected by A. S. Packard, Jr., M. D., by P. R. Uhler. Description of Cambarus Couesi, a New Species of Crawfish from Dakota, by Thomas H. Streets, M. D. U. S. N. On a Carnivorous Dinosaurian from the Dakota Beds of Colorado, by E. D. Cope. A Contribution to the Knowledge of the Ichthyological Fauna of the Green River Shales, by E. D. Cope. On the Genus Erisichthe, by E. D. Cope.